STATE OF NEVADA

Nevada

Criterion-Referenced Tests

MATHEMATICS

REVIEW GUIDE

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Purpose

The Criterion Referenced Tests (CRT), as mandated by legislation (Nevada Revised Statute 389.550), are designed to provide a means of measuring student academic achievement and proficiency in the Nevada State Content and Performance Standards. They are intended to help ensure that students are appropriately prepared in the curricula as set forth in the state standards. Unlike a norm-referenced test that is designed to compare an individual student, school, district, or state test score to an average score as determined by an entire test-taking population, the criterion-referenced test score is reported in terms of both group and individual student outcomes based on a pre-determined criterion of correct responses to measure proficiency and achievement levels.

This review guide is intended to be used by teachers, principals, and school districts as a supplemental tool — one that complements current efforts aimed at preparing students for the state proficiency examinations and/or remedial efforts based in part on student test performance. Each test includes only a portion of the curriculum content that students are expected to know. Although the guide provides a sampling of representative items for the CRT, the sample of items does not constitute a practice test and was not designed to provide "drill" activities.

Rationale and Philosophy

The Nevada comprehensive assessment system serves as an ongoing evaluative technique that allows monitoring of the extent to which students are acquiring necessary knowledge and skills. While necessary knowledge and skills may be characterized in multiple ways, they are primarily defined through the state content and performance standards that provide the basis of aligned curriculum and instructional practice. Assessment can be viewed as multi-faceted. It can be considered as an objective monitoring tool that stands outside the triangle of standards, curriculum, and instruction. It can also be regarded as an integral aspect of curriculum and as an instructional tool. It may be that different assessment strategies can serve these multiple facets. If so, as is the case with standards, curriculum, and instruction, multiple forms of assessment, including varied large-scale assessments and site-based assessments, must be interlocked or aligned. As such, Nevada's assessment efforts are part of statewide systemic reform.

National Assessment of Educational Progress (NAEP)

Nevada is among the states that receive Title I funding and must therefore participate in state NAEP norm-referenced assessments in reading and mathematics at grades 4 and 8. A sample of Nevada students will be tested through the National Assessment of Educational Progress program in reading annually each spring from years 2002 to 2010 and in mathematics from 2003 to 2010. In addition, the NAEP science assessment will be given in years 2004 and 2008 and the writing assessment will be given in years 2002, 2006, and 2010. Information on these assessments may be obtained at http://nces.ed.gov/nationsreportcard/.

Norm-Referenced Assessment

The norm-referenced assessments, as described in Nevada Revised Statute 389.015, are administered annually each winter to every Nevada student in grades 4, 7, and 10. Subjects tested include reading/language arts, mathematics, science, and social studies. The current testing contractor is Riverside Publishing Company, and it is responsible for the distribution and scoring of the Iowa Tests of Basic Skills in grades 4 and 7, and the Iowa Test of Educational Development in grade 10. For more

information about the Iowa Tests of Educational Development in grade 10, go to
http://www.riverpub.com/products/group/ited_a/home.html.

Criterion-Referenced Assessment

The Nevada CRT program was initially mandated in 1999 and piloted in the 2000-2001 school year in mathematics and reading in the 3rd and 5th grades. The 5th grade science test and the 8th grade mathematics, reading, and science tests were field tested in the 2002-2003 school year. The test items are drafted by Nevada teachers with the assistance of the WestEd Regional Educational Laboratory, the Nevada Department of Education, and Measured Progress. Nevada test items undergo a thorough review for alignment with Nevada Standards and for possible bias. Students are tested within 10 days either side of the 120th day of instruction. Each test takes approximately 120 minutes and contains between 50 and 75 items. Ten to fifteen field test items, used for future test development, are embedded in the total item count number.

Since each form of assessment taken individually may serve a narrower purpose, each assessment in the Nevada Proficiency Examination Program must be considered in conjunction with all other forms of assessment. This concept is consistent with the adage that the whole is greater than the sum of its parts. Each form of assessment provides useful bits of information, but the interpretation of student and school achievement is better informed by looking at the influence of multiple measures. (See Figures 1 and 2.)

Figure 1 — A Complementary System Of State-, Local-, And Building-Level Assessment Practices
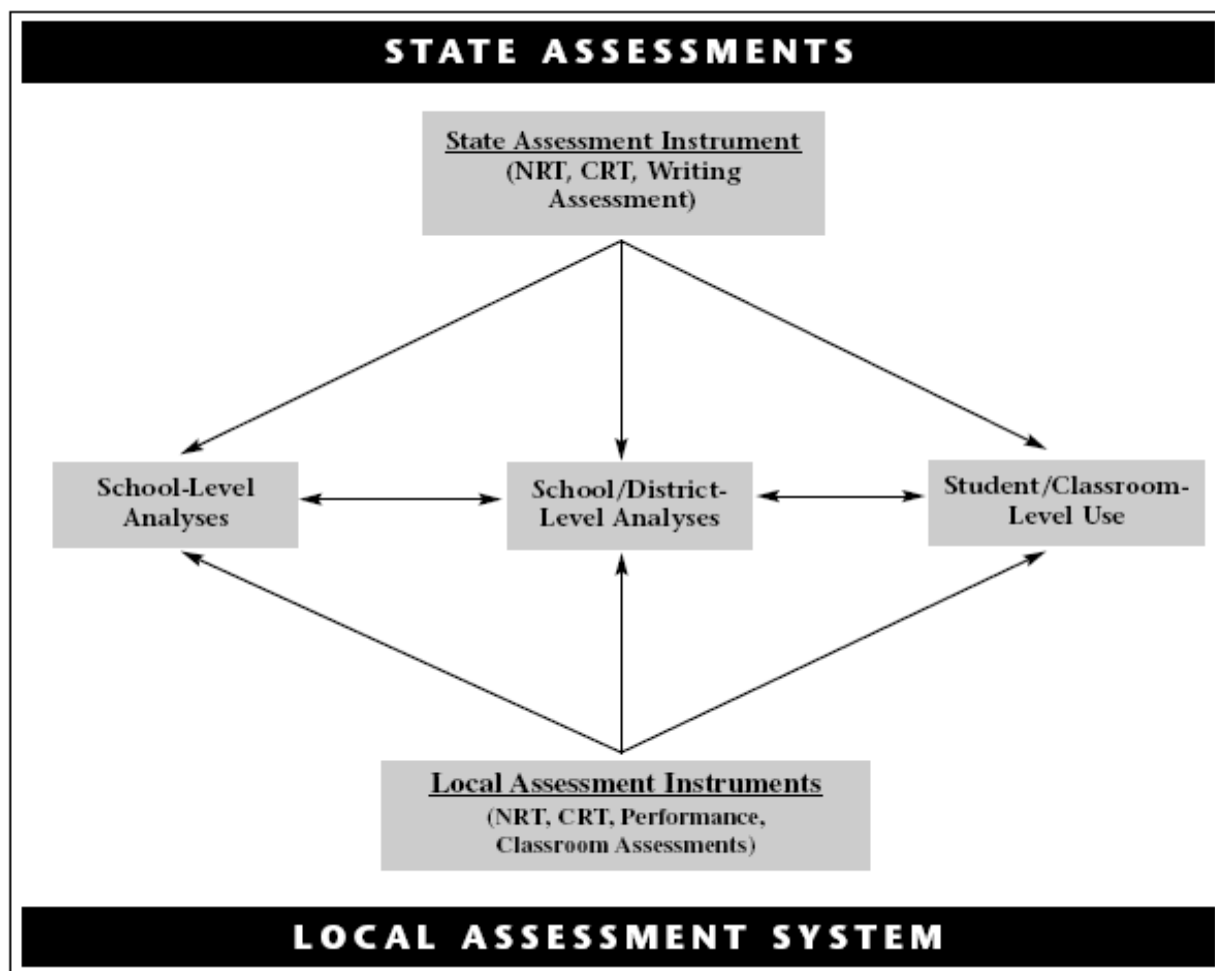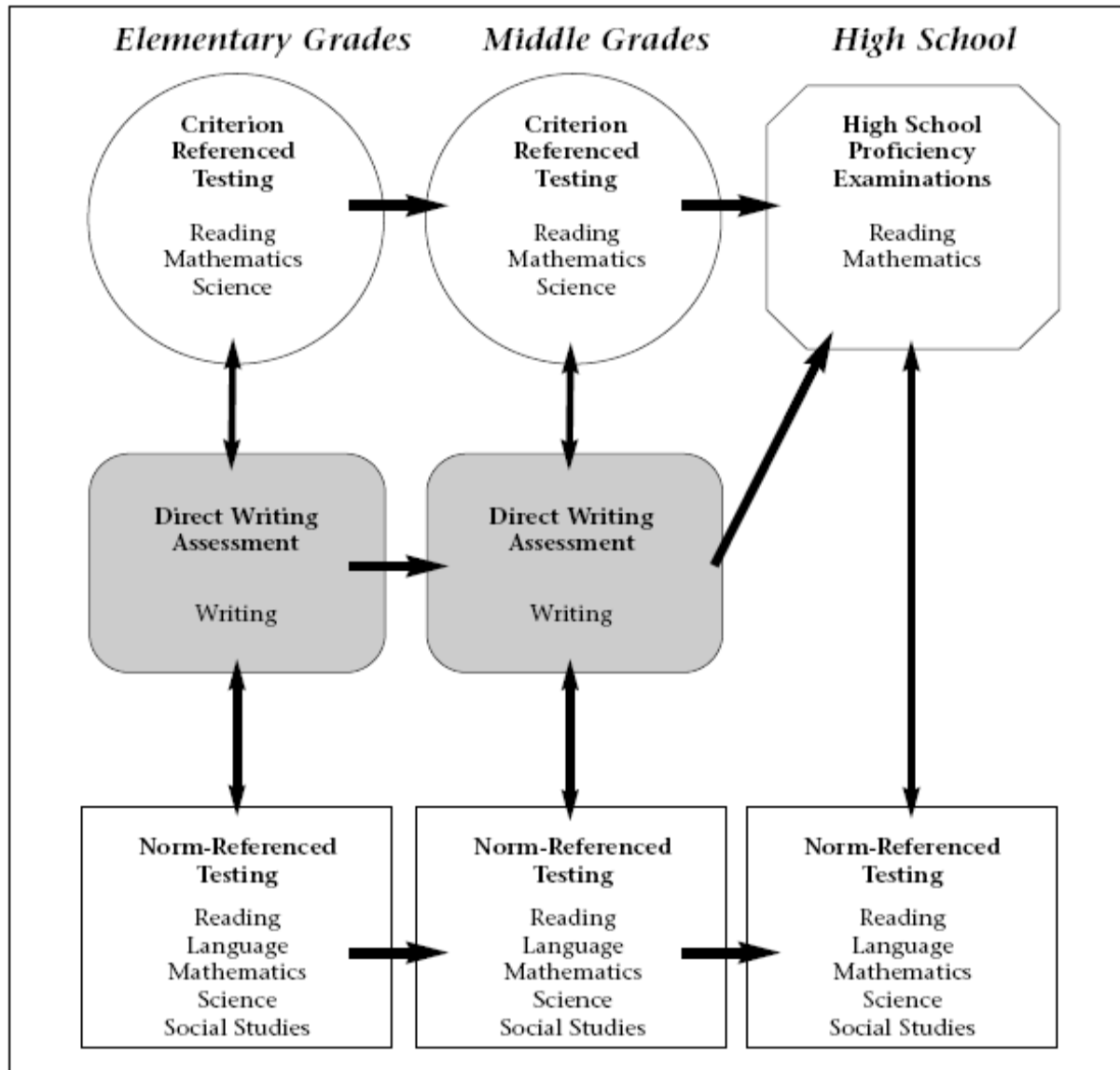
Figure 2 — State-level Assessment Flow

| Elementary Grades	Middle Grades	High School
Criterion Referenced Testing Reading Mathematics Science	**Criterion Referenced Testing** Reading Mathematics Science	**High School Proficiency Examinations** Reading Mathematics
Direct Writing Assessment Writing	**Direct Writing Assessment** Writing	
Norm-Referenced Testing Reading Language Mathematics Science Social Studies	**Norm-Referenced Testing** Reading Language Mathematics Science Social Studies	**Norm-Referenced Testing** Reading Language Mathematics Science Social Studies

Accountability and Alignment

Current reform initiatives, most recently the federal No Child Left Behind Act, are built on the notion of "results-based" accountability. Stated simply, students are responsible for learning standards-based content knowledge and skills, and educators are responsible for providing students with the opportunity to learn and demonstrate that knowledge and those skills.

This much is known about accountability systems and the role of assessments: When the stakes are high, whether applied to students or to schools, the assessments drive classroom instruction and/or behavior and there is motivation to perform well on the accountability measures. Directing instructional change can be desirable and is arguably the goal or role of accountability. How assessments affect instruction or curriculum is a key concern and leads to the issue of alignment between standards and assessments. Unless this alignment is clear, the results of accountability cannot be reliable.

For the assessments and the accountability system to support the overall goals of improving student learning and school improvement, the assessments must measure the standards. Unfortunately, the language of "standards" is not always easily applied to assessment or measurement. Work must be done to translate the standards into a form that is conducive to assessment, yet does not compromise academic expectations. This can be achieved in multiple ways and has been accomplished in Nevada using the following method (See Figure 3.).

Figure 3 — Translation is one step in the alignment
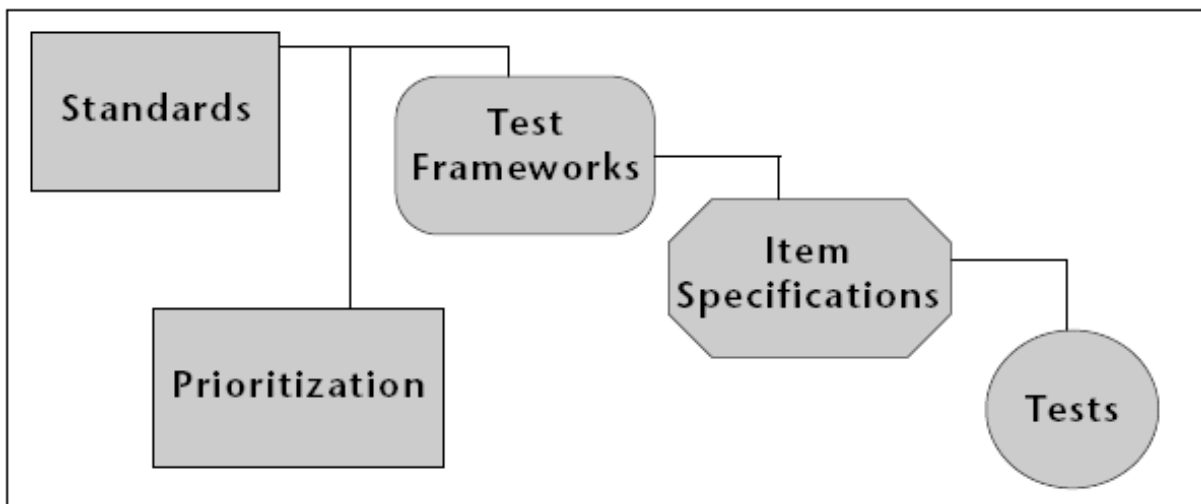
The articulation of standards into a form appropriate for school- and classroom-level assessments is needed for a variety of reasons. First of all, it provides a clear plan for developing test items and tasks. This gives some assurance that, at the state level, measurements are aligned with expected proficiency of student performance based on the state standards. In addition, it supports the development of school district or classroom assessments that are aligned to both the state academic expectations and other forms of assessment that comprise the total assessment system. Aligning different types of assessments is required to achieve systemic reform.

The articulation of standards, ultimately in the form of assessment, also helps serve another critical purpose. It communicates what is expected from students in the form of knowledge and skills acquisition as well as what is expected from schools in terms of curriculum and instructional delivery. In addition, students, parents, and teachers must know how students will be assessed and the decisions that will be made based on their performance.

One of the critical features of the interpretation of standards in Nevada has been the prioritization of standards. After the standards were written and adopted, a statewide committee of district-nominated educators were brought together to make decisions regarding the assessment of the standards. Groups of teachers and other educators had the task of taking each standard and objective and noting whether it was indicative of being enduring (i.e., essential knowledge and skills students need to internalize and retain), important (i.e., knowledge and skills students need to expand their understanding, make connections, and comprehend new or unfamiliar information), or worthwhile (i.e., students should be familiar with key concepts, ideas, facts, and terms). Next, educators made decisions as to whether a standard/objective might best be assessed at the state or local level. This process resulted in a clear subset of standards and objectives that were denoted as being enduring or important as well as testable at the state level.

The prioritization process is important for several reasons. First, the breadth and depth of the Nevada Content Standards make it very difficult to provide a comprehensive assessment. Second, although a lengthy assessment process might be seen as optimal, cost and time spent testing are practical constraints. Third, the prioritization process allows for a finer distinction in those aspects of the standards that are essential for state assessment. This, of course, is a critical undertaking. As stated previously, testing will direct curriculum and instruction, and any narrowing of curricular scope could be detrimental to including all the standards in classroom instruction. It is important to note that the prioritization process did not exclude any of the standards/objectives from assessment. Instead, it called for the assessment of all standards/objectives at the local level, and a specified set of knowledge/skills to be assessed at the state level.

Development

The test development process for state assessments is comprehensive and involves national and local educators, as well as technical assistance from regional education laboratories and testing contractors. Shown in Figure 4 is the general development process. It starts with the state standards followed by the development of test frameworks and specifications and the review of these documents by a Technical Advisory Committee (TAC) and policy boards. After approval, Nevada educators begin the item writing process, which includes the drafting of items/tasks and the qualitative bias review of test items/tasks and reading passages. Once drafted and reviewed, items are subjected to a field administration where the items are field-tested with students. Based on a statistical and qualitative review of the piloted items, test forms are constructed, submitted for a comprehensive review, and ultimately formally administered to students.

The cornerstone of the development process of the Nevada Proficiency Examination Program is teacher involvement in the drafting and reviewing of test items. Prior to writing items, teachers are provided with a thorough training that is designed to assist in drafting quality items that are free from bias and that are clearly aligned to specific prioritized content standards. Throughout item writing sessions, time is dedicated to peer review of item drafts, including validation of the matching of items to specific content skills.

After items are written, they are edited by a testing contractor and subsequently submitted for a comprehensive, qualitative review for potential bias. Although a variety of educators and other citizens are involved in the review process, teachers always serve in this primary role. Items are analyzed to ensure they do not convey insensitivity to a particular group, do not violate privacy issues, and do not differentially impact opportunity and access. Reliance on teacher involvement in the writing and review process provides confidence that the high school proficiency examinations accurately measure content being taught in Nevada classrooms.

Figure 4 — The NPEP Development Process
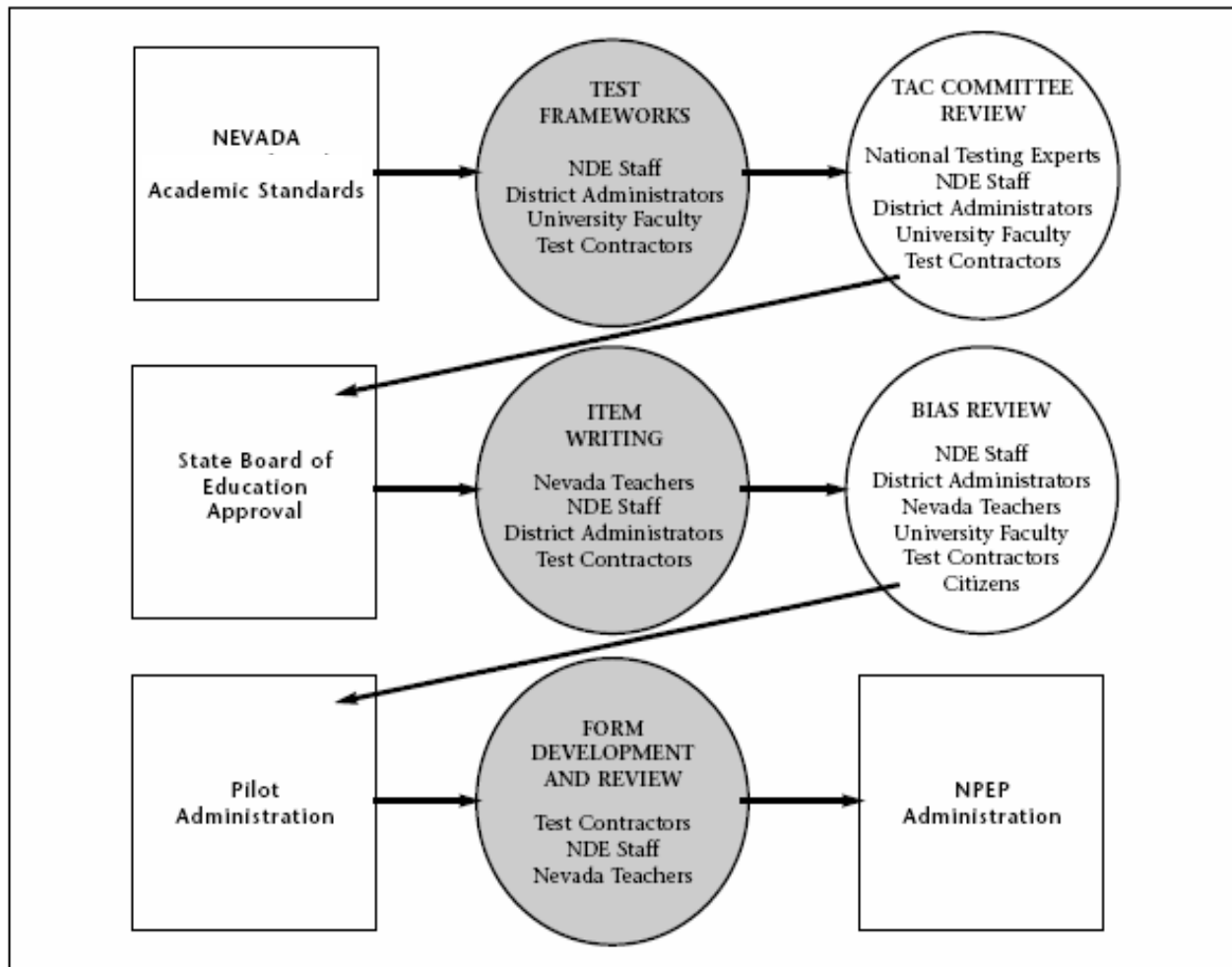
Constructed-Response Items

Constructed-response items are included in the fourth through eighth grade criterion referenced tests. The constructed-response items present students with a question or questions that require students to respond in written form. Typically items ask students to not only recall knowledge from a passage, but also demonstrate more complex cognitive behaviors such as organizing, summarizing, comparing, relating, analyzing, inferring, concluding, predicting, solving, and/or applying. A constructed-response item can come in several different formats. An item may be specific in its request (e.g., "Describe three different ways that…") or more open-ended (e.g., "Describe different ways that…and explain why…").

Constructed-responses will have a set, which scaffolds the students' thinking, and directions for the task. Students receive a score of 0-3 points on their answer, with 0 being the lowest and 3 being the highest. A score of 2 or 3 is deemed proficient. A student's score depends on how closely his or her answer matches the description in the item-specific rubric and the anchor papers for each constructed-response item.

For each constructed-response item, an item specific rubric is designed based on the general rubric. (See page xx for the fifth grade example.) Anchor papers, which are exemplary responses of typical student responses at each score point, are selected to guide the trained readers who score students' responses.

Reporting

In order for assessments to serve the purposes of improving student learning and classroom instruction, assessment results must be reported in a manner that facilitates the interpretation of student performance. The reporting of results must be tied directly to the expectations for student learning.

The state provides a variety of score reports in paper format including student, school, district, and state level summary reports. Additionally, "raw" data is provided to school districts in electronic format to allow for more precise analyses. The integration of results from the multiple levels of assessment (i.e., state vs. classroom) requires the use of electronic media. The state is currently pursuing the adoption of web-based reporting software that can make the "raw" data available in varying degrees of specificity to all education stakeholders. In particular, teachers would be able to access data representing their own classroom, school, and/or district.

Although the electronic transfer of results is optimal, the paper reports disseminated by the state must still convey important information with clarity. The student level summary report conveys both diagnostic and general achievement information (see Figure 5 for a 5th grade example). It provides information pertaining to the number of items possible, the number of items correct, and the percentage of items answered correctly relative to a particular content standard (i.e., in Reading, *Read to Comprehend*, *Interpret and Evaluate Literature*, or in Math, *Algebra and Functions*). In addition, it provides information on the cognitive domain (i.e., in Reading, *Developing an Interpretation* or *Procedural Knowledge* or in Math, *Procedural Knowledge*).

The scale score obtained by the student is specified at the top of the score sheet and a key is provided at the bottom qualifying the achievement levels by descriptors of the scale scores, i.e., emerging/developing, approaching standard, meeting standard, or exceeding standard. The scale score is derived by mapping each raw score to a scale score through a linear transformation process where student ability, test difficulty, and student guessing are factored into the equation. The cut scores of 200 for *Approaches Standard* and 300 for *Meets Standard* were established during the Nevada Standard Setting process in 2002. The *Exceeds Standard* cut is also fixed, but may vary minimally for each test. While the raw score percentage correct required to attain each achievement category may change from year to year and may differ from subject to subject, the scale score cuts remain constant. As a result, for some test forms or subjects, students could receive relatively high percentages of correct answers and not meet the standard, while with other forms they could receive relatively moderate scores and could meet or even exceed the standard, depending on the difficulty of the test form and the achievement level cuts established in the standard setting process.

The number/percentage correct information provided on the Student-Level Summary Score Report has limited diagnostic value. For a particular administration, it does indicate performance relative to the more specified content areas; but the limited number of questions related to any particular standard or domain, in addition to the number of skills encompassed within the standard, prevents a highly reliable estimate of performance. However, if this information is combined with classroom-based information, a strong diagnostic picture can be created. For example, if a student correctly answers 5 of 10 items pertaining to *Numbers and Number Sense* on the state test, it would suggest some relative weakness. However, because each test form is but a sampling of content from the standards, it is important to validate the state level performance information with classroom level information relative to *Numbers and Number Sense* (assignment grades, class quizzes, teacher observation, etc.) before major remedial efforts would be implemented for any student.

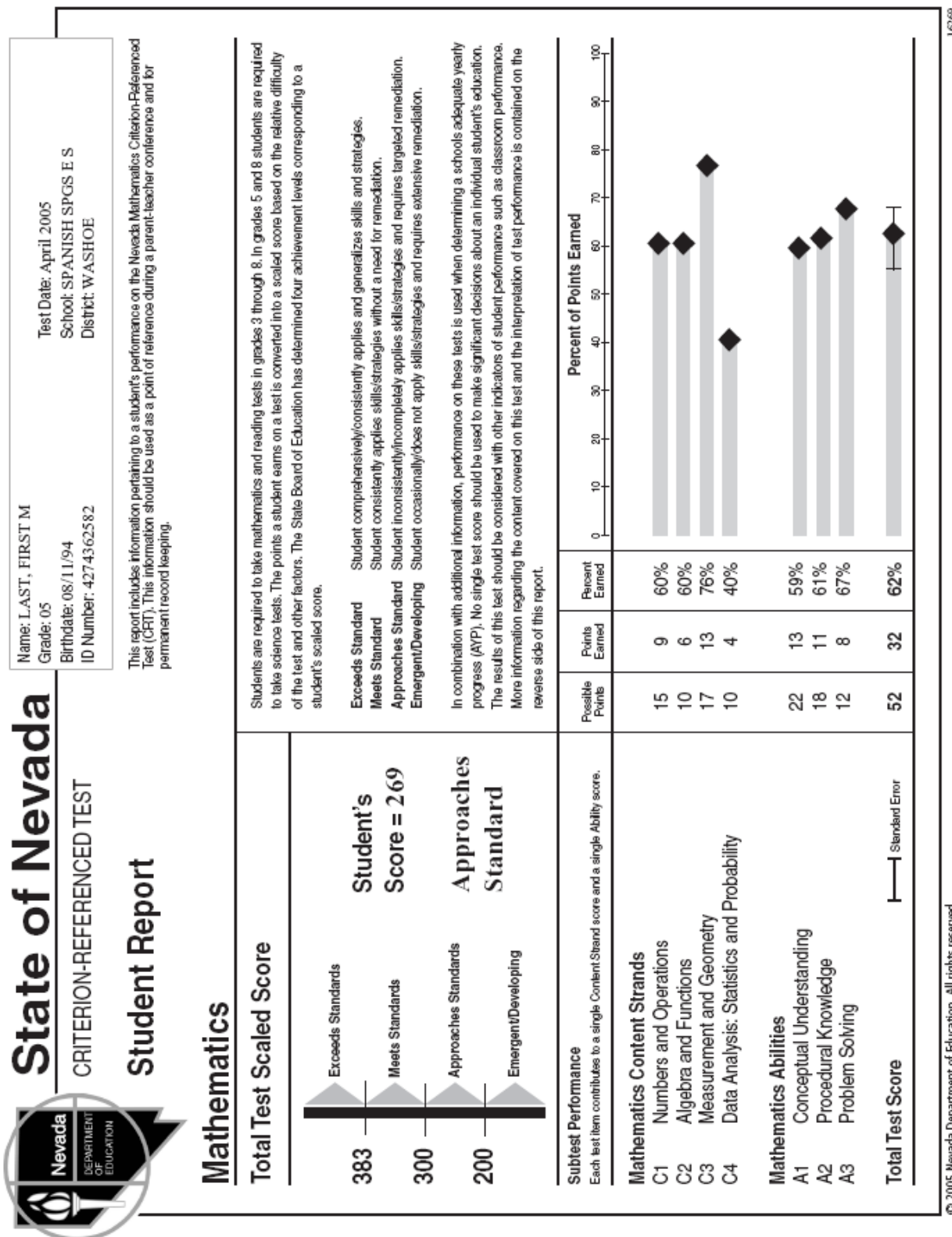# Figure 5 — Student-Level Summary Score Report Grade 5 (Front)

State of Nevada

CRITERION-REFERENCED TEST

Student Report

Name: LAST, FIRST M
Grade: 05
Birthdate: 08/11/94
ID Number: 4274362582

Test Date: April 2005
School: SPANISH SPGS E S
District: WASHOE

This report includes information pertaining to a student's performance on the Nevada Mathematics Criterion-Referenced Test (CRT). This information should be used as a point of reference during a parent-teacher conference and for permanent record keeping.

Mathematics

Total Test Scaled Score

383 — Exceeds Standards

Student's Score = 269

Approaches Standard

300 — Meets Standards

200 — Approaches Standards

Emergent/Developing

Students are required to take mathematics and reading tests in grades 3 through 8. In grades 5 and 8 students are required to take science tests. The points a student earns on a test is converted into a scaled score based on the relative difficulty of the test and other factors. The State Board of Education has determined four achievement levels corresponding to a student's scaled score.

Exceeds Standard — Student comprehensively/consistently applies and generalizes skills and strategies.
Meets Standard — Student consistently applies skills/strategies without a need for remediation.
Approaches Standard — Student inconsistently/incompletely applies skills/strategies and requires targeted remediation.
Emergent/Developing — Student occasionally/does not apply skills/strategies and requires extensive remediation.

In combination with additional information, performance on these tests is used when determining a schools adequate yearly progress (AYP). No single test score should be used to make significant decisions about an individual student's education. The results of this test should be considered with other indicators of student performance such as classroom performance. More information regarding the content covered on this test and the interpretation of test performance is contained on the reverse side of this report.

Subtest Performance
Each test item contributes to a single Content Strand score and a single Ability score.

	Possible Points	Points Earned	Percent Earned	Percent of Points Earned
Mathematics Content Strands				
C1 Numbers and Operations	15	9	60%	
C2 Algebra and Functions	10	6	60%	
C3 Measurement and Geometry	17	13	76%	
C4 Data Analysis: Statistics and Probability	10	4	40%	
Mathematics Abilities				
A1 Conceptual Understanding	22	13	59%	
A2 Procedural Knowledge	18	11	61%	
A3 Problem Solving	12	8	67%	
Total Test Score	52	32	62%	

⊢ Standard Error

Figure 5 — Student-Level Summary Score Report Grade 5 (Back)

MATHEMATICS

Additional information about the Nevada content areas can be viewed at the Nevada Department of Education website, www.doe.nv.gov. The Nevada Criterion-Referenced Examination in Mathematics will contain items that test how well a student can perform the following mathematical activities:

MATHEMATICS CONTENT STRANDS
Numbers and Operations (C1)
- Use and apply multiplication and corresponding division facts through 12's.
- Generate and solve addition, subtraction, multiplication, and division problems using whole numbers in practical situations.
- Use order of operations to solve problems.
- Multiply and divide multi-digit numbers by 2-digit numbers, including strategies for powers of 10.
- Use and identify place value.
- Use models and drawings to identify, compare, add, and subtract fractions with like denominators and to add and subtract decimals; use both to solve problems.

Algebra Functions (C2)
- Using whole numbers as a replacement set, find possible solutions to such inequalities as 8+4>n.
- Use variables in open sentences and to describe simple functions and relationships.
- Generate number sequences given the first term and any basic computation rule (e.g., given a 4 and the rule of add 6, 10, 16, 22, 28, ...).

Measurement and Geometry
- Estimate measures of length, volume, capacity, quantity, and weight, communicating degree of accuracy needed and when a more precise measure is required.
- Determine totals and change due for monetary amounts in problem-solving situations.
- Communicate the difference between perimeter and area.
- Identify equivalent periods of time, including relationships between and among seconds, minutes, hours, days, months, and years (e.g., 60 sec = 1 min).
- Draw and classify triangles, according to their properties; (e.g., right, scalene, obtuse, equilateral); identify and draw circles and parts of circles, describing the relationships between the various parts (e.g., central angle, arc, diameter).
- Identify shapes that have congruence, similarity, and/or symmetry of figures using a variety of methods including transformational motions (e.g., translations/slide, rotations/turn, reflection/flip, enlargement/reduction) and models, drawings, and measurement tools.
- Using a grid, identify coordinates for a given point or locate points of given coordinates in the first quadrant.

- Identify, describe, compare, and classify two- and three-dimensional figures by relevant properties including number of vertices (corners), edges, and shapes of faces; identify and predict the effects of combining, dividing, and changing shapes into other shapes.
- Identify, describe, define, and draw geometric figures including points, intersecting, perpendicular and parallel lines, line segments, rays, angles, and planes.

Data Analysis: Statistics and Probability (C4)
- Collect, organize, read, and interpret data using a variety of graphic representations including tables, line plots, stem and leaf plots, scatter plots, histograms; use data to draw and explain conclusions and predictions.
- Model and then compute measures of central tendency including mean, median, and mode.

MATHEMATICS ABILITIES
Conceptual Understanding (A1)
- Label, define, and compare/contrast concepts and translate from one mode of representation to another.
- Recognize and identify properties of a given concept, and use models, diagrams, and symbols to represent it.
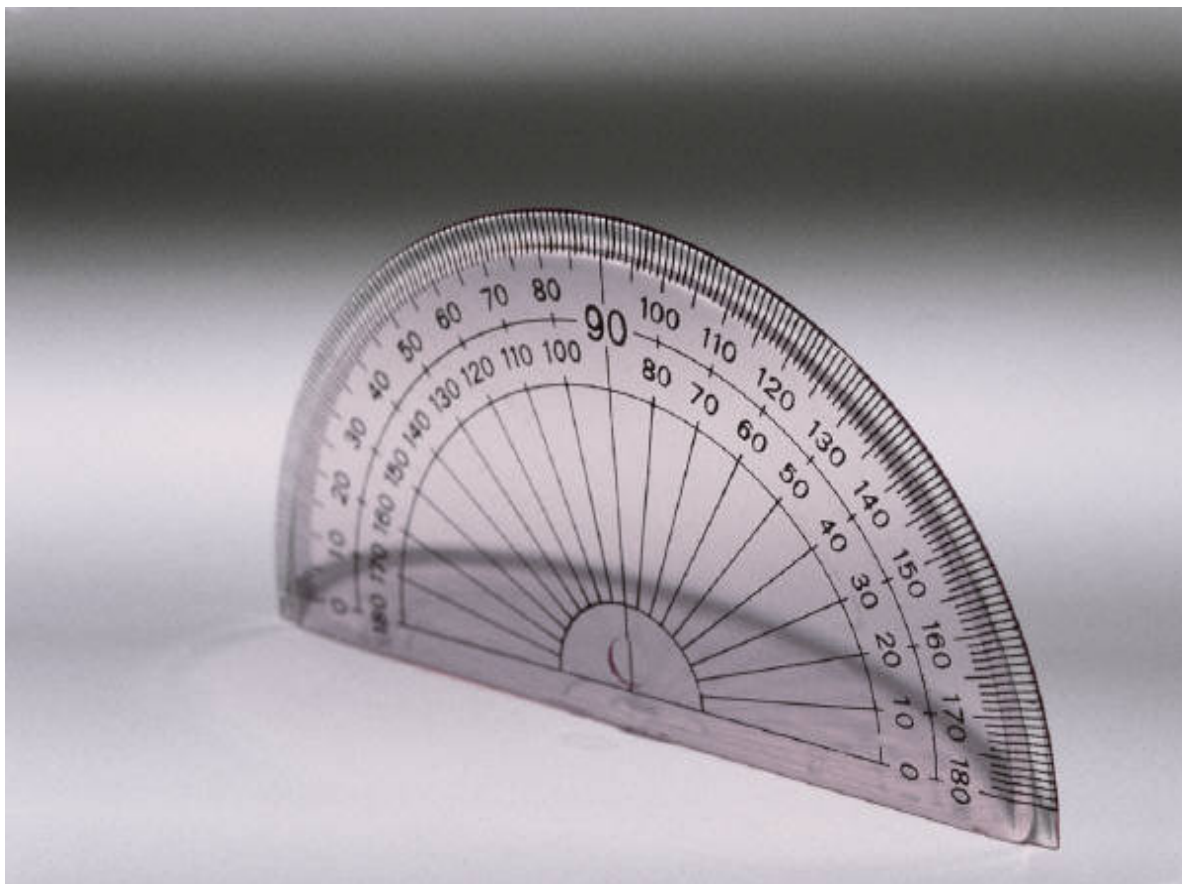
Procedural Knowledge (A2)
- Recognize when a procedure is appropriate, give reasons for steps in a procedure, and accurately execute procedures in a problem situation.
- Verify the results of procedures using analysis and/or models.
- Identify and/or demonstrate the appropriate use of tools (calculators, protractors, rules, etc.).

Problem Solving (A3)
- Analyze situations to determine common properties and structures, recognize patterns, and form conjectures.
- Apply a variety of combinations of strategies to solve problems.
- Verify conclusions, judge the validity of conjectures, and construct valid arguments.

The test results presented in this report should be used in combination with other information to get a complete picture of a student's true achievement level. Many factors can affect a student's performance on a test either positively (e.g. ability, luck, easy items) or negatively (e.g., test anxiety, lack of sleep, hard items). Because of this, a student's true achievement level may be greater than or less than his/her performance on a single test. These differences are sometimes referred to as measurement error and can affect the reliability of a test score. The standard error for the student's total performance on this test has been reported. Using the student's total score, the standard error identifies the range within which the student's true achievement level falls.

The student's total score and corresponding achievement level are based on the student's responses to a large number of test items. Subtest or strand performance is based on far fewer items. Because of this, measurement error is greater and as a result, subtest scores should be used as general guides for identifying the areas where the student performed well and the areas that need additional focus for improvement. Subtest performance has been reported to provide the student with useful information regarding strengths and weaknesses on a given testing occasion but this information should be interpreted cautiously and important instructional decisions should not be made based upon subtest scores alone.

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NEVADA MATHEMATICS CRT

Students have different abilities, needs, and interests. Yet everyone needs to be able to use mathematics in his or her personal life, in the workplace, and in further study. All students deserve an opportunity to understand the power and beauty of mathematics. Students need to learn a new set of mathematics basics that enable them to compute fluently and to solve problems creatively and resourcefully.

— National Council of Teachers of Mathematics
http://www.nctm.org/standards/overview.htm

Comprehensive mathematical knowledge is essential for success in today's world. Society needs individuals who have sound estimation skills and number and spatial sense, who are competent using and interpreting data, and who can use appropriate technology resources to solve problems and make informed decisions. These skills are essential if students are to become successful citizens, life-long learners, and competitive workers in a global market place.

The goals of mathematics education in Nevada include the following:

- All students will have knowledge of basic mathematical facts and relationships and the ability to perform computations;

- All students will have the ability to make sound estimations and to make sense of number relationships;

- All students will have the ability to read, interpret, and create graphs, tables, and charts;

- All students will have the ability to make geometric observations, measurements, and constructions; and

- All students will have the ability to understand the effective, appropriate, and efficient use of models and mathematical tools, including calculators and computer technology.

The *Nevada Mathematics Standards* provide the framework for a comprehensive K-12 mathematics program and are intended to guide curriculum, instruction, and assessment as well as other policies and practices that affect student learning. The standards serve as a foundation for teachers and curriculum specialists as they create curriculum and adopt teaching practices relevant to the needs, strengths, and diversity of Nevada's students and communities. The standards also provide clear direction for meaningful pre-service and in-service professional development. In essence, the standards help Nevada's school districts build cohesive and comprehensive systems for ensuring that all students achieve at high levels.

The *Nevada Mathematics Standards* consist of five content strands (Standards 1.0-5.0) and four process strands (Standards 6.0-9.0). The process strands are carefully integrated within the content standards to emphasize their interconnectedness. This integration is meant to emphasize the importance of teaching mathematics within the context of an application so students will not only know important skills and content but also how to use their knowledge and skills to reason and solve problems.

Content Standard 1: Numbers, Number Sense, and Computation

Students will develop their ability to solve problems, communicate, reason, and make connections within and beyond the field of mathematics. Students will accurately calculate and use estimation techniques, number relationships, operation rules, and algorithms. They will determine the reasonableness of answers and the accuracy of solutions.

Content Standard 2: Patterns, Functions, and Algebra

Students will develop their ability to solve problems, communicate, reason, and make connections within and beyond the field of mathematics. Students will use various algebraic methods to analyze, illustrate, extend, and create numerous representations (words, numbers, tables, and graphs) of patterns, functions, and algebraic relations as modeled in practical situations.

Content Standard 3: Measurement

Students will develop their ability to solve problems, communicate, reason and make connections within and beyond the field of mathematics. Students will use appropriate tools and techniques of measurement to determine, estimate, record, and verify direct and indirect measurements.

Content Standard 4: Spatial Relationships and Geometry

Students will develop their ability to solve problems, communicate, and make connections within and beyond the field of mathematics. Students will identify, represent, verify, and apply spatial relationships and geometric properties.

Content Standard 5: Data Analysis

Students will develop their ability to solve problems, communicate, reason, and make connections within and beyond the field of mathematics. Students will collect, organize, display, interpret, and analyze data to determine statistical relationships and probability projections.

Process Standard 6: Problem Solving

Students will develop their ability to solve problems by engaging in developmentally appropriate problem solving opportunities in which there is a need to use various approaches to investigate and understand mathematical concepts in order to: formulate their own problems; find solutions to problems from everyday situations; develop and apply strategies to solve a wide variety of problems; and integrate mathematical reasoning, communication and connections.

Process Standard 7: Mathematical Communication

Students will develop their ability to communicate mathematically by solving problems in which there is a need to obtain information from the real world through reading, listening, and observing in order to: translate this information into a mathematical language and symbols; process this information mathematically; and present results in written, oral and visual formats.

Process Standard 8: Mathematical Reasoning

Students will develop their ability to reason mathematically by solving problems in which there is a need to investigate significant mathematical ideas and construct their own learning in all content areas in order to justify their thinking; reinforce and extend their logical reasoning abilities; reflect on and clarify their own thinking; and ask questions to extend their thinking.

Process Standard 9: Mathematical Connections

> Students will develop the ability to make mathematical connections by solving problems in which there is a need to view mathematics as an integrated whole, identifying relationships between content strands, and inte-grating mathematics with other disciplines, allowing the flexibility to approach problems in a variety of ways within and beyond the field of mathematics.

Each content and process standard consists of sets of specific grade-level benchmarks or indicators of progress to identify developmentally appropriate knowledge and skills that students should learn at each stage of their K-12 mathematics education. The grade-level benchmarks or indicators of progress also establish the criteria for student accountability and assessment at each grade level.

Nevada Criterion Referenced Mathematics Tests

The Nevada Criterion Referenced Tests (CRT) in mathematics are designed to assess students' proficiency with respect to the 1998 Nevada K-12 Standards for Mathematics Education. A framework reference and an item specification matrix are used to guide the development of the Nevada CRT assessments. The framework and matrix are based on the commonality of the content and goals of the Nevada K-12 Standards for Mathematics Education, the National Assessment of Educational Progress (NAEP), and the National Council of Teachers of Mathematics (NCTM) Curriculum and Evaluation Standards for Mathematics. The Nevada CRT framework document is available for review on the Nevada Department of Education website at http://www.nde.state.nv.us

The CRT framework calls for assessment items in four mathematics content clusters based on the three cognitive ability domains suggested by the NAEP assessment framework (conceptual understanding, procedural knowledge, and problem-solving skills) and the priorities set forth in the Nevada K-12 Standards for Mathematics Education.

Content Clusters

> C1 – Numbers and Operations (Standard 1)
> C2 – Algebra and Functions (Standard 2)
> C3 – Measurement and Geometry (Standards 3 & 4)*
> C4 – Data Analysis, Statistics and Probability (Standard 5)
>
> *Approximately half of the items in Content Cluster 3 (C3) are from Standard 3 (Measurement) and the other half are from Standard 4 (Geometry).

Ability Levels (Cognitive Domains)

> A1 – Conceptual Understanding
> A2 – Procedures
> A3 – Problem Solving

To demonstrate conceptual understanding (A1), students should show that they are able to:

- Recognize, label, and generate examples and/or non-examples of concepts.
- Use and interrelate models, diagrams, manipulatives, and varied representations of mathematical concepts.
- Use and apply mathematical facts and definitions.

- Identify and apply principles (e.g., provide and recognize valid statements generalizing relationships among concepts in conditional form).
- Compare, contrast, and integrate related concepts and principles to the nature of the concepts and principles.
- Recognize, interpret, and apply the signs, symbols, and terms used to represent concepts.
- Interpret assumptions and relations involving concepts in mathematical settings.

To demonstrate procedural knowledge (A2), students should show that they are able to:

- Select and appropriately apply correct procedures.
- Verify or justify the correctness of a procedure using concrete models or symbolic methods.
- Extend or modify procedures to deal with factors inherent in problem settings.
- Apply numerical algorithms appropriately to specific mathematical situations or settings.
- Perform non-computational functions such as rounding and ordering.
- Describe why a particular procedure will give a correct answer for a problem in a specific context or defined situation.

To demonstrate problem-solving skills (A3), students should show that they are able to:

- Correctly apply their accumulated knowledge of Mathematics in new situations.
- Recognize and formulate problems.
- Determine the efficacy and relevance of data or information in problem-solving situations.
- Use combinations of strategies, data, models, and procedures to answer questions.
- Use reasoning in new settings.
- Judge the reasonableness and correctness of solutions.

3ʳᵈ GRADE MATHEMATICS

An overview of the Criterion Referenced Test program is provided at the beginning of this review guide. Information about the purpose, rationale & philosophy, accountability & alignment, development, and reporting can answer questions to the broader details of the program.

The materials that follow include the performance standards for grade 3, the matrix of the test configuration, and examples of test items. A number of test items include explanations for the correct answer and distracters of each test item. It is important to note that the following examples are examples. They are not intended to establish limits of what will be on the test or limits to the ways the standards can be assessed.

Content standards 1 through 5 deal with students' abilities to understand and use mathematical concepts. Listed below the five content standards are the performance indicators. Each standard has performance indicators that target specific competencies for grade 3 within the standard. The following is a description of the standards and those performance indicators tested. Those tested at the state level are check marked. The performance indicators for the process strands are also assessed; however, they are not reported separately.

Nevada Mathematics Standards and Progress Indicators

Standard 1:   *Numbers, Number Sense, and Computation*
Students will develop their ability to solve problems, communicate, reason, and make connections within and beyond the field of mathematics. Students will accurately calculate and use estimation techniques, number relationships, operation rules, and algorithms. They will determine the reasonableness of answers and the accuracy of solutions.

Grade 3 Progress Indicators

By the end of Grade 3, students know and are able to do everything required in the previous grades and:

- ✔ Immediately recall and use addition, subtraction, and multiplication facts to 81.
- ✔ Add and subtract multi-digit numbers with regrouping.
- ✔ Generate and solve 2-step addition and subtraction and 1-step multiplication problems based on practical situations using pencil and paper, mental computation, and estimation.
- ✔ Add and subtract decimals using money as a model.
- • Model and explain multiplication, including as repeated addition.
- • Read, write, order, and compare numbers from 0-999; read and write number words.
- • Round to nearest tens and hundreds to determine reasonableness of the answer; read and write number words.
- ✔ Use, model, and identify place value positions up to 10,000.
- ✔ Model, sketch, and label fractions with denominators to 10; write fractions with numbers and words.

Standard 2: *Patterns, Functions, and Algebra*
Students will develop their ability to solve problems, communicate, reason, and make connections within and beyond the field of mathematics. Students will use various algebraic methods to analyze, illustrate, extend, and create numerous representations (words, numbers, tables, and graphs) of patterns, functions, and algebraic relations as modeled in practical situations.

Grade 3 Progress Indicators

By the end of Grade 3, students know and are able to do everything required in the previous grades and:

- ✔ Recognize, describe, and create patterns using numbers; use number patterns and their extensions to solve problems.
- ✔ Identify missing terms and missing numbers in open number sentences involving number facts in addition and subtraction.
- ✔ Complete number sentences with the appropriate words and symbols for addition, subtraction, less than, greater than, and equal to (+, –, <, >, =).

Standard 3: *Measurement*
Students will develop their ability to solve problems, communicate, reason and make connections within and beyond the field of mathematics. Students will use appropriate tools and techniques of measurement to determine, estimate, record, and verify direct and indirect measurements.

Grade 3 Progress Indicators

By the end of Grade 3, students know and are able to do everything required in the previous grades and:

- ✔ Select and use appropriate units of measurement; measure to a required degree of accuracy, and record results.
- • Estimate and use measuring devices with standard and non-standard units to measure length, surface area, liquid volume, capacity, temperature, and weight, communicating the concepts of more, less, and equivalent.
- ✔ Read, write, and use money notation determining possible combinations of coins and bills to equal given amounts.
- ✔ Tell time to the nearest minute, using analog and digital clocks, and identify elapsed time.

Standard 4: *Spatial Relationships and Geometry*
Students will develop their ability to solve problems, communicate, and make connections within and beyond the field of mathematics. Students will identify, represent, verify, and apply spatial relationships and geometric properties.

Grade 3 Progress Indicators

By the end of Grade 3, students know and are able to do everything required in the previous grades and:

- ✔ Describe, sketch, compare, and contrast plane geometric figures.
- • Demonstrate and describe the motion (transformation) of geometric figures as a slide, rotation, or a flip.
- • Compare, contrast, sketch, model, and build two- and three-dimensional geometric figures and objects.

Standard 5: *Data Analysis*

Students will develop their ability to solve problems, communicate, reason, and make connections within and beyond the field of mathematics. They will collect, organize, display, interpret, and analyze data to determine statistical relationships and probability projections.

Grade 3 Progress Indicators

By the end of Grade 3, students know and are able to do everything required in the previous grades and:

✔ Collect, organize, display, and describe simple data using number lines, pictographs, bar graphs, and frequency tables.

✔ Use concepts of probability (e.g., impossible, likely, certain) to make predictions about future events.

The matrix below explains the configuration of the mathematics examination.

CRT Grade 3 Mathematics Examination Item Matrix

Content Clusters/ Ability Levels (Cognitive Domains)	C1 Numbers and Operations	C2 Algebra and Functions	C3* Measurement and Geometry	C4 Data Analysis, Statistics, and Probability	Total Items	Percent
A1 Conceptual Understanding	5	4	5	4	18	40%
A2 Procedures	4	3	3	2	12	27%
A3 Problem Solving	5	2	5	3	15	33%
Total Items	14	9	13	9	45	100%
Percent	31%	20%	29%	20%	100%	

*Approximately half of the items in Content Cluster 3 (C3) are from Standard 3 (Measurement) and the other half are from Standard 4 (Geometry).
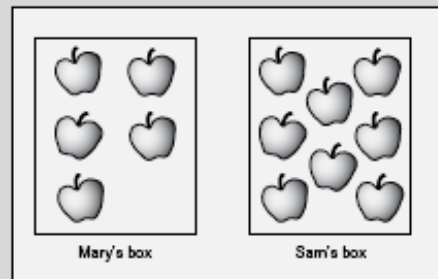
Reporting Category: C1 – Numbers and Operations

Ability Level: A1 – Conceptual Understanding

Performance Indicator: Immediately recall and use addition, subtraction, and multiplication facts to 81.

Test Item:

The pictures below show the number of apples Mary and Sam each picked from a tree and put into a box.

Mary's box   Sam's box

How many more apples did Sam pick than Mary?

A   3 apples

B   5 apples

C   8 apples

D   13 apples

Correct Response A: The student should be able to recall subtraction facts.

Sam has 8 apples.

Mary has 5 apples.

8 – 5 = 3 apples.

Response B: This response is incorrect. It represents an error in which the student may have not known the subtraction fact correctly or may have counted the apples in Mary's box and given that as the correct answer.

Response C: This response is incorrect. It represents an error in which the student may have not known the subtraction fact correctly or may have counted the apples in Sam's box and given that as the correct answer.

Response D: This response is incorrect. It represents an error in which the student may have decided this was an addition problem and used the addition fact 5 + 8 = 13.
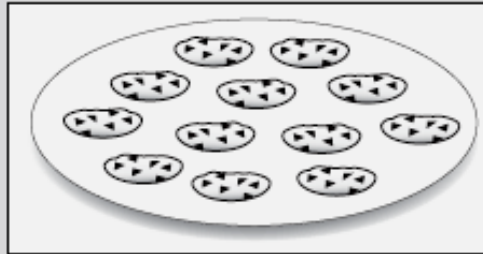
Reporting Category: C1 – Numbers and Operations

Ability Level: A2 – Procedural Skills

Performance Indicator: Model, sketch, and label fractions with denominators to 10; write fractions with numbers and words.

Test Item:

What number is $\frac{1}{3}$ of the cookies on this plate?

A   3

B   4

C   6

D   12

Correct Response B: The student should understand that one-third means one out of every three. There are 3 groups of 4 cookies (or 12 cookies) on the plate. Therefore, one group of cookies out of 3 groups of cookies is equivalent to 4 cookies.

Response A: This response is incorrect. It represents an error in which the student found one-fourth of the cookies on the plate.

Response C: This response is incorrect. It represents an error in which the student found one-half of the cookies on the plate.

Response D: This response is incorrect. It represents an error in which the student found the total number of cookies on the plate.

Reporting Category: C1 – Numbers and Operations

Ability Level: A3 – Problem Solving

Performance Indicator: Generate and solve two-step addition and one-step multiplication problems based on practical situations using pencil and paper, mental computation, and estimation.

Test Item:

Miguel bought a game for $3.74, and a ball for $2.03. How much money, **rounded to the nearer dollar**, did he spend?

A $2.00

B $4.00

C $5.00

D $6.00

Correct Response D: The student should be able to round the prices to the nearer dollar before finding the sum.

$3.74 rounds up to $4.00 and $2.03 rounds down to $2.00.

Then, $4.00 + $2.00 = $6.00.

Response A: This response is incorrect. It represents an error in which the student may have rounded only one price.

$2.03 \approx $2.00.

Response B: This response is incorrect. It represents an error in which the student may have rounded only one price.

$3.74 \approx $4.00.

Response C: This response is incorrect. It represents an error in which the student may have rounded both prices down to the next dollar so that

$3.00 + $2.00 = $5.00.

Reporting Category: C2 – Algebra and Functions

Ability Level: A1 – Conceptual Understanding

Performance Indicator: Identify missing terms and missing numbers in open number sentences involving number facts in addition and subtraction.

Test Item:

> **What number makes this number sentence true?**
>
> $23 + \square = 57$
>
> A   23
>
> B   34
>
> C   40
>
> D   80

Correct Response B: The student should be able to apply the subtraction algorithm for two-digit numbers in this question.

$57 - 23 = 34$

Response A: This response is incorrect. It represents an error in which the student may have selected a number that appears within the question itself.

Response C: This response is incorrect. It represents an error in which the student may have rounded 57 to 60 and 23 to 20, and then found the difference.

$60 - 20 = 40$

Response D: This response is incorrect. It represents an error in which the student may have found the sum of 57 and 23.

$57 + 23 = 80$

3rd GRADE MATHEMATICS

Reporting Category: C2 – Algebra and Functions

Ability Level: A2 – Procedural Skill

Performance Indicator: Complete number sentences with the appropriate words and symbols for addition, subtraction, less than, greater than, and equal to $(+, -, <, >, =)$.

Test Item:

> Which symbol below should go in the box to make this number sentence true?
>
> $20 - 17 \square 10 - 7$
>
> A +
>
> B >
>
> C <
>
> D =

Correct Response D: The student should know the subtraction algorithm and subtraction facts and be able to relate those facts by using the appropriate symbol.

$20 - 17 = 3$ and $10 - 7 = 3$ and $3 = 3$

Therefore, $20 - 17 = 10 - 7$.

Response A: This response is incorrect. It represents an error in which the student chooses a symbol that does not create a number sentence. The + symbol just adds a third operation to the two existing operations.

Response B: This response is incorrect. It represents an error in which the student believes that $20 - 17$ is greater than $10 - 7$ or does not know the meaning of the symbol.

Response C: This response is incorrect. It represents an error in which the student believes that $20 - 17$ is less than $10 - 7$ or does not know the meaning of the symbol.

3rd GRADE MATHEMATICS

Reporting Category: C2 – Algebra and Functions

Ability Level: A3 – Problem Solving

Performance Indicator: Recognize, describe, and create patterns using numbers; use number patterns and their extensions to solve problems.

Test Item:

Which rule below **best** describes this skip counting pattern?

100, 95, 90, 85, 80, 75, 70, 65,…

A   Add 5 to each number to get the next number.

B   Subtract 5 from each number to get the next number.

C   Multiply each number by 5 to get the next number.

D   Divide each number by 5 to get the next number.

Correct Response B: The student should be able to recognize and describe with words the pattern shown in the question. Each number after the first number is 5 less than the preceding number.

Response A: This response is incorrect. It represents an error in which the student may have read the number pattern from right to left or misunderstood the difference between the operations of addition and subtraction.

Response C: This response is incorrect. It represents an error in which the student may have misunderstood the difference between the operations of subtraction and multiplication.

Response D: This response is incorrect. It represents an error in which the student may have misunderstood the difference between the operations of subtraction and division.

3rd GRADE MATHEMATICS

Reporting Category: C3 – Measurement and Geometry

Ability Level: A1 – Conceptual Understanding

Performance Indicator: Select and use appropriate units of measurement; measure to a required degree of accuracy, and record results.

Test Item:

Which list shows the units below, in order from the largest to smallest unit?

pint, gallon, cup, quart

A   cup, quart, gallon, pint

B   cup, pint, quart, gallon

C   gallon, quart, pint, cup

D   gallon, pint, cup, quart

Correct Response C: The student should understand the concepts of more than (and less than) in the context of common units of measurement for the volume of a liquid.

                       The volume of a gallon is more than the volume of a quart, which is more than the volume of a pint, which is more than the volume of a cup.

Response A: This response is incorrect. It represents an error in which the student may not understand the relative sizes of the different units.

Response B: This response is incorrect. It represents an error in which the student may have ordered the units from smallest to largest.

Response D: This response is incorrect. It represents an error in which the student may not understand the relative sizes of the different units.

Reporting Category: C3 – Measurement and Geometry

Ability Level: A2 – Procedural Skills

Performance Indicator: Describe, sketch, compare, and contrast plane geometric figures.

Test Item:

Which pair of shapes below could you put together without overlapping to make this

A

B

C

D
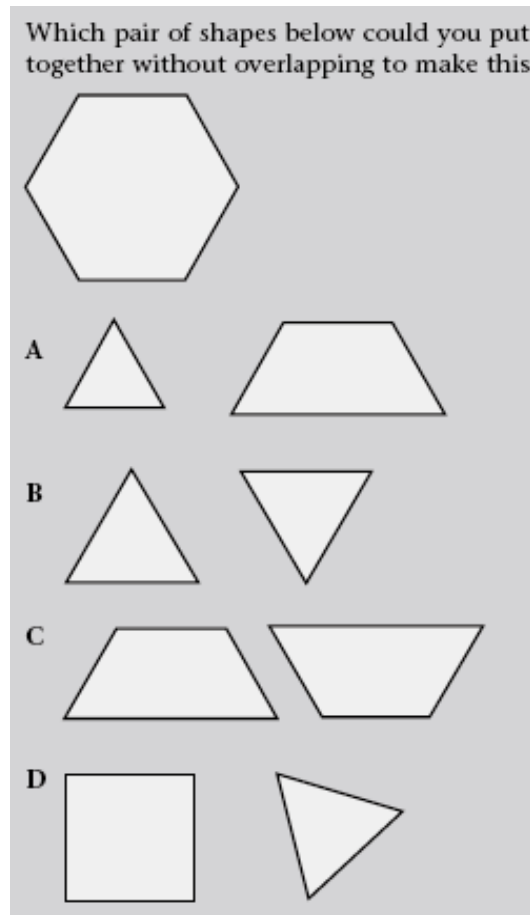
Correct Response C: The student should be able to visualize and build a two-dimensional geometric figure from other two-dimensional geometric figures. The two trapezoids shown, when aligned on their longest sides, form the regular hexagon shown at the top of the question.

Response A: This response is incorrect. The two shapes shown can be put together to make a triangle or a parallelogram, but not a regular hexagon.

Response B: This response is incorrect. The two shapes shown can be put together to make a rhombus, but not a regular hexagon.

Response D: This response is incorrect. The two shapes shown can be put together to make a composite shape, but not a regular hexagon.

3rd GRADE MATHEMATICS

Reporting Category: C3 – Measurement and Geometry

Ability Level: A3 – Problem Solving

Performance Indicator: Tell time to the nearest minute, using analog and digital clocks, and identify elapsed time.

Test Item:

A movie started at 7:15 PM. It lasted 1 hour and 45 minutes. At what time did the movie end?

A   9:15 PM

B   9:00 PM

C   8:45 PM

D   8:15 PM

Correct Response B: The student should be able to add hours and minutes to arrive at the time the movie ended.

7:15 + 1 hour and 45 minutes = 8:60 = 9:00

Response A: This response is incorrect. It represents an error in which the student may have rounded or mistaken 1 hour and 45 minutes for 2 hours. Then, 7:15 + 2 = 9:15.

Response C: This response is incorrect. It represents an error in which the student may not have included the 15 minutes from the 7:15 when finding the time the movie ended.

Response D: This response is incorrect. It represents an error in which the student may not have included 45 minutes from the 1 hour and 45 minutes when finding the time the movie ended.
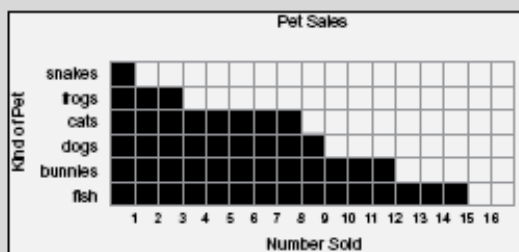
Reporting Category: C4 – Data Analysis and Probability

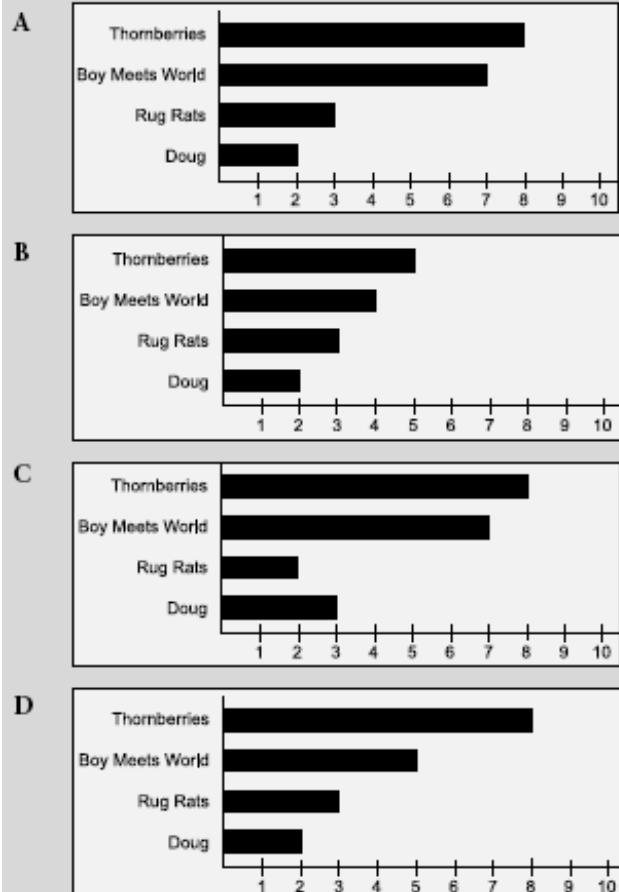Ability Level: A1 – Conceptual Understanding

Performance Indicator: Collect, organize, display, and describe simple data using number lines, pictographs, bar graphs, and frequency tables.

Test Item:

The graph shows how many different pets were sold at Percy's Pet Store on a given day.

Pet Sales

Kind of Pet	
snakes	
frogs	
cats	
dogs	
bunnies	
fish	

Number Sold: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

How many bunnies were sold?

A   5

B   11

C   12

D   15

Correct Response C: The student should be able to read data presented in the graph. Moving from left to right starting in the row labeled "bunnies" there are 12 boxes shaded. Each of those boxes represents one bunny sold. Therefore, 12 bunnies were sold.

Response A: This response is incorrect. It represents an error in which the student may have counted 5 unshaded boxes from right to left in the row labeled "bunnies."

Response B: This response is incorrect. It represents an error in which the student may have misread the number of shaded boxes.

Response D: This response is incorrect. It represents an error in which the student may have misread the label for kinds of pets and simply chosen the largest number.

Reporting Category: C4 – Data Analysis and Probability

Ability Level: A2 – Procedural Skills

Performance Indicator: Collect, organize, display, and describe simple data using number lines, pictographs, bar graphs, and frequency tables.

Test Item:

The students in Ms. Gomez's class tallied their favorite TV shows in the chart below.

Thornberries	JHT III
Boy Meets World	JHT II
Rug Rats	III
Doug	II

Which bar graph below correctly shows the students' choices?

A

B

C

D

(Continued on next page)

Correct Response A: The student should be able to recognize data displayed accurately in more than one format.

8 students voted for the *Thornberries*.
7 students voted for *Boy Meets World*.
3 students voted for *Rug Rats*.
2 students voted for *Doug*.

These numbers match the numbers in the tally chart.

Response B: This response is incorrect. It represents an error in which the length of each bar is merely one less than the bar above it.

Response C: This response is incorrect. It represents an error in which the correct lengths of the bars for *Rug Rats* and *Doug* were reversed.

Response D: This response is incorrect. It represents an error in which the lengths of the bars in the graph do not match the numbers of students in the tally chart for *Boy Meets World*.

|	
Correct Response A:	The student should be able to recognize data displayed accurately in more than one format.
	8 students voted for the *Thornberries*.
	7 students voted for *Boy Meets World*.
	3 students voted for *Rug Rats*.
	2 students voted for *Doug*.
	These numbers match the numbers in the tally chart.
Response B:	This response is incorrect. It represents an error in which the length of each bar is merely one less than the bar above it.
Response C:	This response is incorrect. It represents an error in which the correct lengths of the bars for *Rug Rats* and *Doug* were reversed.
Response D:	This response is incorrect. It represents an error in which the lengths of the bars in the graph do not match the numbers of students in the tally chart for *Boy Meets World*.

Reporting Category: C4 – Data Analysis and Probability

Ability Level: A3 – Problem Solving

Performance Indicator: Use concepts of probability (e.g., impossible, likely, certain) to make predictions about future events.

Test Item:

Manuel, Dominique, Chase, and Roberta each have a different spinner.
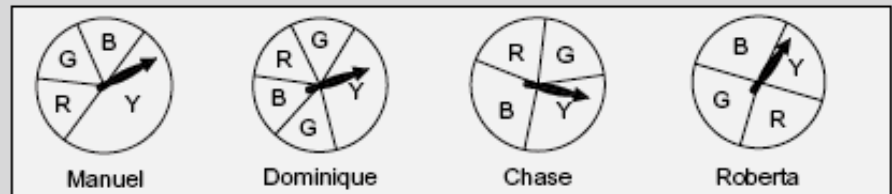
Which student's spinner is **least likely** to land on Y?

A   Manuel's

B   Dominique's

C   Chase's

D   Roberta's

Correct Response D: The student should understand that the probability of landing on a Y is related to the area of the section(s) of the spinner labeled Y. The less the total area of a spinner labeled Y the less likely the spinner will land on Y.

The area of the section of Roberta's spinner labeled Y appears to cover about one-fourth (or 25%) of the total area of her spinner. The area of the section labeled Y on the other three spinners appears to cover an area greater than one-fourth of each of those spinners. Therefore, Roberta's spinner is least likely to land on Y.

Response A: This response is incorrect. The area covered by the section labeled Y on Manuel's spinner appears to be about one-half of the total area of the spinner. Therefore Manuel's spinner is the most likely to land on Y.

Response B: This response is incorrect. The area covered by the section labeled Y on Dominique's spinner appears to be about one-third of the total area of the spinner.

Response C: This response is incorrect. The area covered by the section labeled Y on Chase's spinner appears to be more than one-fourth of the total area of the spinner.

1 Which drawing below correctly represents one-fourth?

A

B

C

D
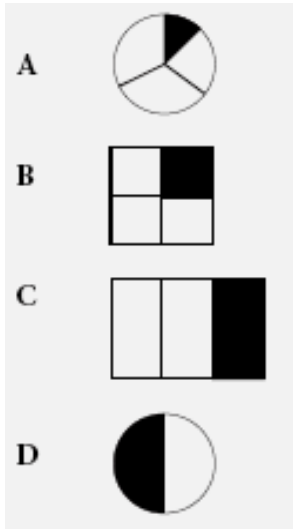
2 What number should go in the box to make this number sentence true?

$243 + \square = 561$
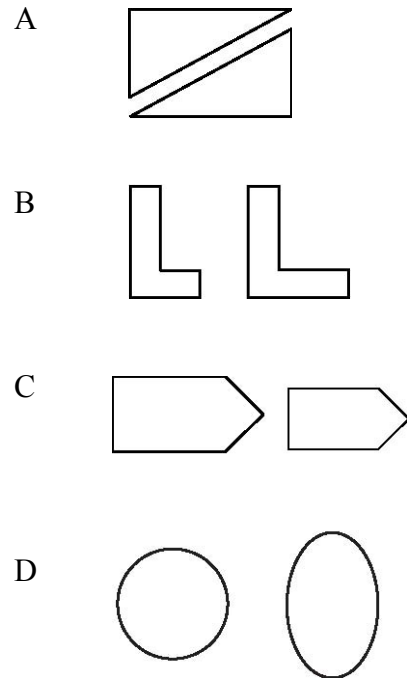
A 218

B 222

C 318

D 322

3 Jim bought 7 **packs** of gum. There were 8 **sticks** of gum in each pack. How many **sticks** of gum did Jim buy?

A 15

B 16

C 56

D 78

4 Which pair of figures below appears to be congruent?
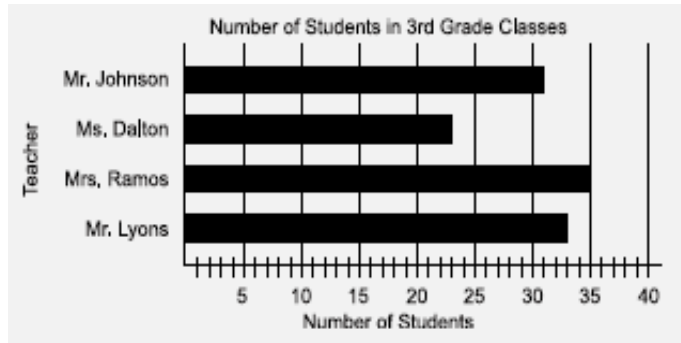
A

B

C

D

5 Which is the best ESTIMATE for the problem

$67 - 29 = \square \ ?$

A 20

B 30

C 40

D 50

6 Which statement below is true for this graph?

Number of Students in 3rd Grade Classes

A Mrs. Ramos has 35 more students than Mr. Johnson.

B Mr. Johnson has 12 more students than Ms. Dalton.

C Ms. Dalton has 2 less students than Mr. Lyons.

D Mr. Johnson has 2 less students than Mr. Lyons.

7 At his work, Mr. Brown puts wheels on new tricycles. How many wheels would he need for six tricycles? Use the table below to help you.

Number of Tricycles	1	2	3	4	5	
Number of Wheels	3	6	9	12	?	?

A 15

B 16

C 18

D 21

8
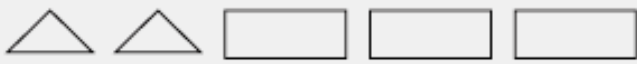
What time is shown on the clock?

A 4:41

B 5:41

C 8:23

D 8:25

9 Look at the drawing of a triangular prism below.

Which set of pictures shows all the faces of the triangular prism?

10 Jill opened four bags of candies to find how many of each color she had. Use the table to answer this question.

Number of Candies in Each Bag

Color / Bag	yellow	orange	green	blue	brown	red
A	9	4	5	5	20	13
B	7	8	9	7	19	8
C	10	5	7	4	19	12
D	7	8	2	6	23	13

What is the total number of candies in Bag C?

A 55

B 57

C 67

D 75

11 There are 12 cookies on the plate below. Six of the cookies are chocolate chip. What fraction of the total cookies on the plate are chocolate chip?

A $\dfrac{3}{12}$

B $\dfrac{1}{3}$

C $\dfrac{2}{6}$

D $\dfrac{6}{12}$

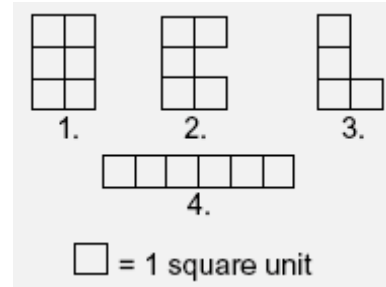**12** Which symbol should go in the circle to make this number sentence true?

78 ○ 21 = 99

A +

B −

C >

D <

13 Which number phrase shows how many eyes 8 dogs should have?

A 2×4

B 2×8

C $8 + 2$

D $8 + 4$

14 Which two shapes shown below have the same area?

□ = 1 square unit

A shapes 1 and 3

B shapes 1 and 4

C shapes 2 and 3

D shapes 2 and 4

15 Don has twelve frozen fruit bars in his freezer. Three of the bars are raspberry-flavored, two are strawberry-flavored, five are orange-flavored, and the rest are lemon-flavored. Which describes how likely it would be for Don to randomly select a lemon-flavored bar from the freezer on his first try?

A certain

B very likely

C not likely

D impossible

Item Number	Reporting Category	Ability Level	Answer Key
1	C1	A2	B
2	C2	A1	C
3	C1	A3	C
4	C3	A1	A
5	C1	A2	C
6	C4	A3	D
7	C2	A3	C
8	C3	A1	A
9	C3	A3	A
10	C2	A1	B
11	C1	A2	D
12	C4	A1	A
13	C1	A1	B
14	C3	A2	B
15	C4	A3	C

5th GRADE MATHEMATICS

An overview of the Criterion Referenced Test program is provided at the beginning of this review guide. Information about the purpose, rationale & philosophy, accountability & alignment, development, and reporting can answer questions to the broader details of the program.

The materials that follow include the performance standards for grade 5, the matrix of the test configuration, and examples of test items. A number of test items include explanations for the correct answer and distracters of each test item. It is important to note that the following examples are examples. They are not intended to establish limits of what will be on the test or limits to the ways the standards can be assessed.

Content standards 1 through 5 deal with students' abilities to understand and use mathematical concepts. Listed below the five content standards are the performance indicators. Each standard has performance indicators that target specific competencies for grade 5 within the standard. The following is a description of the standards and those performance indicators tested. Those tested at the state level are check marked. The performance indicators for the process strands are also assessed; however, they are not reported separately.

Nevada Mathematics Standards and Progress Indicators

Standard 1: *Numbers, Number Sense, and Computation*
Students will develop their ability to solve problems, communicate, reason, and make connections within and beyond the field of mathematics. Students will accurately calculate and use estimation techniques, number relationships, operation rules, and algorithms. They will determine the reasonableness of answers and the accuracy of solutions.

Grade 5 Progress Indicators

By the end of Grade 5, students know and are able to do everything required in the previous grades and:

- ✔ Use and apply multiplication and corresponding division facts through 12's.
- ✔ Generate and solve addition, subtraction, multiplication, and division problems using whole numbers in practical situations.
- ✔ Use order of operations to solve problems.
- ✔ Add and subtract decimals; multiply and divide decimals by whole numbers in problems representing practical situations.
- ✔ Multiply and divide multi-digit numbers by 2-digit numbers, including strategies for powers of 10.
- • Compare and order negative numbers within the context of everyday happenings (e.g., temperature) and plot those numbers on a number line.
- • When rounding, identify which place value will be most helpful in estimating an answer and determine the reasonableness of the answer.
- ✔ Use and identify place value.
- ✔ Use models and drawings to identify, compare, add, and subtract fractions with like denominators and to add and subtract decimals; use both to solve problems.

Standard 2: *Patterns, Functions, and Algebra*
Students will develop their ability to solve problems, communicate, reason, and make connections within and beyond the field of mathematics. Students will use various algebraic methods to analyze, illustrate, extend, and create numerous representations (words, numbers, tables, and graphs) of patterns, functions, and algebraic relations as modeled in practical situations.

Grade 5 Progress Indicators

By the end of Grade 5, students know and are able to do everything required in the previous grades and:

- Identify, describe, and explain patterns and relationships in the number system (e.g., formed by triangular numbers, perfect squares, arithmetic and geometric sequences) using concrete materials, paper and pencil, and calculators.
- ✔ Using whole numbers as a replacement set, find possible solutions to such inequalities as $8 + 4 > n$.
- ✔ Use variables in open sentences and to describe simple functions and relationships.
- ✔ Generate number sequences given the first term and any basic computation rule of add 6, 10, 16, 22, 28, …).
- Solve simple equations using a variety of methods (e.g., inverse operations, mental math, and estimate and verify).

Standard 3: *Measurement*
Students will develop their ability to solve problems, communicate, reason and make connections within and beyond the field of mathematics. Students will use appropriate tools and techniques of measurement to determine, estimate, record, and verify direct and indirect measurements.

Grade 5 Progress Indicators

By the end of Grade 5, students know and are able to do everything required in the previous grades and:

- ✔ Estimate measures of length, volume, capacity, quantity, and weight, communicating degree of accuracy needed and when a more precise measure is required.
- ✔ Determine totals and change due for monetary amounts in problem-solving situations.
- ✔ Communicate the difference between perimeter and area.
- ✔ Identify equivalent periods of time, including relationships between and among seconds, minutes, hours, days, months, and years (e.g., 60 sec = 1 min).

Standard 4: *Spatial Relationships and Geometry*

Students will develop their ability to solve problems, communicate, and make connections within and beyond the field of mathematics. Students will identify, represent, verify, and apply spatial relationships and geometric properties.

Grade 5 Progress Indicators

By the end of Grade 5, students know and are able to do everything required in the previous grades and:

- ✔ Draw and classify triangles, according to their properties; (e.g., right, scalene, obtuse, equilateral); identify and draw circles and parts of circles, describing the relationships between the various parts (e.g., central angle, arc, diameter).
- ✔ Identify shapes that have congruence, similarity, and/or symmetry of figures using a variety of methods including transformational motions (e.g., translation/slide, rotation/turn, reflection/flip, enlargement/reduction) and models, drawings, and measurement tools.
- ✔ Using a grid, identify coordinates for a given point or locate points of given coordinates in the first quadrant.
- ✔ Identify, describe, compare, and classify two- and three- dimensional figures by relevant properties including number of vertices (corners), edges, and shapes of faces; identify and predict the effects of combining, dividing, and changing shapes into other shapes.
- ✔ Identify, describe, define, and draw geometric figures including points, intersecting, perpendicular and parallel lines, line segments, rays, angles, and planes.

Standard 5: *Data Analysis*

Students will develop their ability to solve problems, communicate, reason, and make connections within and beyond the field of mathematics. They will collect, organize, display, interpret, and analyze data to determine statistical relationships and probability projections.

Grade 5 Progress Indicators

By the end of Grade 5, students know and are able to do everything required in the previous grades and:

- ✔ Collect, organize, read, and interpret data using a variety of graphic representations including tables, line plots, stem-and-leaf plots, scatter plots, histograms; use data to draw and explain conclusions and predictions.
- ✔ Model and then compute measures of central tendency including mean, median, and mode.
- • Describe the limitations of various graph formats; select an appropriate type of graph to accurately represent the data and justify the selection.

Constructed-Response Items

The constructed-response items present students with a question or questions that require students to respond in written form. Students receive a score of 0-3 points on their answer, with 0 being the lowest and 3 being the highest. A score of 2 or 3 is deemed proficient. For each constructed-response item, an item specific rubric is designed based on the general rubric. (See below for example.)

Score Point	Expectation
3	The response completely answers all parts of the question and displays thorough understanding of the skill(s) within the standard being tested. The response provides an answer that: • clearly and correctly indicates the mathematical ideas and processes applied and provides evidence of the problem-solving techniques and/or thinking skills used to solve the problem. • clearly and correctly labels all answers, if required.
2	The response partially, but adequately, answers the question and displays satisfactory understanding of the skill(s) being tested. The response provides an answer that: • correctly completes all parts of the task but contains minor flaws in the reasoning or a minor notational error in recording a solution to a part of the problem. • completes the entire task but uses incomplete, or disorganized information to represent the solution process and/or a problem solution.
1	The response demonstrates a limited understanding of the skill(s) being tested. The response provides an answer that: • correctly solves the problem but does not provide clearly acceptable answers for the entire problem. • provides an acceptable response for one part of the question, but fails to attempt a solution for the other part(s) of the problem
0	The response demonstrates a lack of understanding of the skill(s) being tested. The response provides an answer that: • does not answer the question clearly enough to demonstrate any understanding. • provides incorrect or inappropriate responses to the question.

5ᵗʰ GRADE MATHEMATICS

The checklist below is a guide that teachers and students can use to assist them in writing responses to the constructed-response items.

5ᵀᴴ GRADE
CONSTRUCTED-RESPONSE CHECKLIST

Read and think about the following questions to help you do a good job when you are doing your writing.

Did I think about each question (and/or directions) I read?

                                               Yes   No

Did I use the words in **bold** print in the question to give me information?

                                                 Yes   No

Did I show all my work and include each step needed to complete the problem?

                                                 Yes   No

If I used a diagram, did I label each part of the diagram clearly?

                                                 Yes   No

Did I complete all parts of the question?

                                                 Yes   No

5th GRADE MATHEMATICS

The matrix below explains the configuration of the fifth grade mathematics examination.

CRT Grade 5 Mathematics Examination Item Matrix

Content Clusters/ Ability Levels (Cognitive Domains)	**C1** Numbers and Operations	**C2** Algebra and Functions	**C3*** Measurement and Geometry	**C4** Data Analysis, Statistics, and Probability	Total Items	Percent
A1 Conceptual Understanding	6	4	5	5	20	41%
A2 Procedures	5	3	4	3	15	31%
A3 Problem Solving	2**	4	6**	2**	14	28%
Total Items	13	11	15	10	49	100%
Percent	27%	22%	31%	20%	100%	

*   Approximately half of the items in content Cluster 3 (C3) are from Standard 3 (Measurement) and the other half are from Standard 4 (Geometry).

** Indicates the possibility of a constructed-response item.

Reporting Category: C1 – Numbers and Operations

Ability Level: A1 – Conceptual Understanding

Performance Indicator: Use and identify place value.

Test Item:

Which number is the standard form of four hundred seventy-eight thousand, six hundred eight?

A   400,078,608

B   4,780,680

C   478,680

D   478,608

Correct Response D: The student should have knowledge of place value and be able to convert the words that represent numbers into the standard form of a number.

Four hundred thousand = 400,000

Seventy thousand = 70,000

Eight thousand = 8,000

Six hundred = 600

Eight = 8

400,000 + 70,000 + 8,000 + 600 + 8 = 478,608

Response A: This response is incorrect. It represents an error in which the student may have confused four hundred million for four hundred thousand.

Response B: This response is incorrect. It represents an error in which the student may have confused four million seven hundred eighty thousand for four hundred seventy-eight thousand and confused six hundred eighty for six hundred eight.

Response C: This response is incorrect. It represents an error in which the student may have confused six hundred eighty for six hundred eight.

5ᵗʰ GRADE MATHEMATICS

Reporting Category: C1 – Numbers and Operations

Ability Level: A2 – Procedural Skills

Performance Indicator: Use order of operations to solve problems.

Test Item:

> What is the value of the expression below?
>
> $24 - 3 \times 2 + 21 \div 7$
>
> A   9
>
> B   21
>
> C   45
>
> D   69

Correct Response B: The student should know and apply the order of operations to get the correct answer.

First: $24 - 6 + 21 \div 7$ (6 is the product of 3 and 2)

Next: $24 - 6 + 3$ (3 is the quotient of 21 and 7)

Next: $18 + 3$ (18 is the difference between 24 and 6)

Finally: 21 (21 is the sum of 18 and 3)

Response A: This response is incorrect. It represents an error in which the student may have performed the four operations starting from left to right in the sequence written.

Response C: This response is incorrect. It represents an error in which the student may have done the first three operations from left to right in the sequence written to get 42 and then found the sum of 42 and $(21 \div 7)$. Therefore $42 + 3 = 45$.

Response D: This response is incorrect. It represents an error in which the student may have divided the product of 21 and 23 by 7.

5th GRADE MATHEMATICS

Reporting Category: C1 – Numbers and Operations

Ability Level: A3 – Problem Solving

Performance Indicator: Use models and drawings to identify, compare, add, and subtract fractions with like denominators and to add and subtract decimals; use both to solve problems.

Test Item:

> On Sunday, 0.5 inches of snow fell. On Monday, 1.3 inches of snow fell. How much **more** snow fell on Monday than on Sunday?
>
> A   0.2 inches
>
> B   0.8 inches
>
> C   1.2 inches
>
> D   1.8 inches

Correct Response B: The student should recognize that this problem involves finding the difference between the amount of snow that fell on Monday and the amount of snow that fell on Sunday.

$$1.3 - 0.5 = 0.8$$

Response A: This response is incorrect. It represents an error in which the student may have found the difference between 0.5 and 0.3.

Response C: This response is incorrect. It represents an error in which the student may have found the difference between 0.5 and 0.3 and then added 1.

Response D: This response is incorrect. It represents an error in which the student may have found the sum of 1.3 and 0.5.

Reporting Category: C1 – Numbers and Operations

Ability Level: A3 – Problem Solving

Performance Indicator: Add and subtract decimals; multiply and divide decimals by whole numbers in problems representing practical situations.

Test Item:

> **Write your answer to Question 3 on page 4 in your Answer Booklet. Be sure to answer Parts A, B, and C.**
>
> Scotty went to the post office. He bought three books of 20 first class stamps and 50 postcards. First class stamps cost $0.37 each.
>
> **A** What is the total cost of the first class stamps Scotty bought? Show your work or explain how you got your answer.
>
> **B** If the 50 postcards cost $11.50, what is the cost of one postcard? Show your work or explain how you got your answer.
>
> **C** Find the total cost of the items Scotty bought. Show your work or explain how you got your answer.

Complete and Correct Response

Part A:

(similar to the following):

$22.20

Work:

First find the total number of first class stamps Scotty bought. 3 books 20 stamps per book = 60 first class stamps Then find the total cost of the 60 stamps. 60 stamps × $0.37 per stamp = $22.20

Part B:

$0.23

Work:

If 50 postcards cost $11.50 then divide to find the cost of one postcard. $11.50 ÷ 50 = $0.23

Part C:

$33.70

Work:

To find the total cost of the items Scotty bought, find the sum of the cost of all the first-class stamps and the cost of all the postcards. $22.20 + $11.50 = $33.70

Score Point	Description
3	Student gives correct answer to Parts A, B, and C and shows appropriate work.
2	Student gives correct answer to any two parts and show appropriate work. OR Student gives correct answer to all parts but does not show any appropriate work. (Student shows understanding of the problem, but makes minor computational errors.)
1	Student gives correct answer to Part A or B only and shows appropriate work for that part. (Student demonstrates minimal understanding of the problem.)
0	Student's response is totally incorrect or irrelevant.

Reporting Category:	C2 – Algebra and Functions
Ability Level:	A1 – Conceptual Understanding
Performance Indicator:	Generate number sequences given the first term and any basic computation rule (e.g., given a 4 and the rule of add 6, the number sequence is: 10, 16, 22, 28...).
Test Item:	

Tom used 1 as the first number in a sequence. After the first number, the numbers form a geometric pattern. If the sequence continues in the same way, what should be the next two numbers?

1, 3, 9, 27, __, __

A   33, 39

B   36, 45

C   45, 63

D   81, 243

Correct Response D: The student should be able to recognize the rule used in the pattern is "multiply by 3." Then, 27 x 3 = 81 and, 81 x 3 = 243.

Response A: This response is incorrect. It represents an error in which the student may have thought the rule was "add 6."

Response B: This response is incorrect. It represents an error in which the student may have thought the rule was "add 9."

Response C: This response is incorrect. It represents an error in which the student may have thought the rule was "add 18."

5th GRADE MATHEMATICS

Reporting Category: C2 – Algebra and Functions

Ability Level: A2 – Procedural Skills

Performance Indicator: Using whole numbers as a replacement set, find possible solutions to such inequalities as 8 + 4 > n.

Test Item:

Which is the **smallest** whole number that can be used in place of n to make the inequality below true?

$18 + n > 24$

A   5

B   6

C   7

D   8

Correct Response C: The student should understand the meaning of the inequality symbol for "greater than."

$18 + 7 > 24$ then, $25 > 24$

Response A: This response is incorrect. It represents an error in which the student may have misunderstood the meaning of the symbol for "greater than" or found an incorrect sum for $18 + 5$.

Response B: This response is incorrect. It represents an error in which the student may have misunderstood the meaning of the symbol for "greater than" or found an incorrect sum for $18 + 6$.

Response D: This response is incorrect. It represents an error in which the student did not choose the *smallest* whole number to replace n that would make the inequality true.

5th GRADE MATHEMATICS

Reporting Category: C2 – Algebra and Functions

Ability Level: A3 – Problem Solving

Performance Indicator: Use variables in open sentences to describe simple functions and relationships.

Test Item:

> Emilio planned to buy some paperback books at the book fair. The books cost $4.25 each. Which number phrase can be used to show the total cost in dollars of b books?
>
> A $b + 4.25$
>
> B $4.25 \times b$
>
> C $b - 4.25$
>
> D $4.25 \div b$

Correct Response B: The student should understand that the product of b, the number of books bought, and $4.25, the cost per book, will give the total cost.

Response A: This response is incorrect. It represents an error in which the student chose the sum of $4.25 and the number of books to get the total cost.

Response C: This response is incorrect. It represents an error in which the student chose the difference between the number of books and $4.25 to get the total cost.

Response D: This response is incorrect. It represents an error in which the student chose the quotient of $4.25 and the number of books to get the total cost.
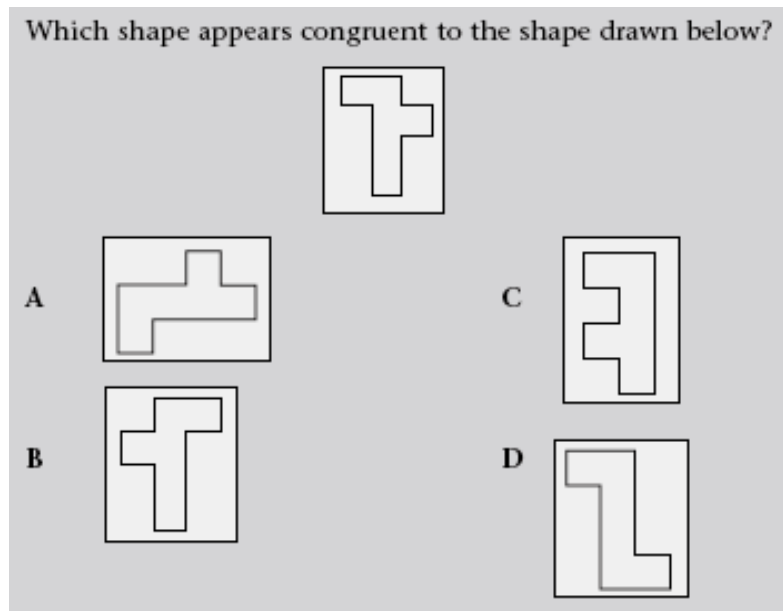
5th GRADE MATHEMATICS

Reporting Category:	C3 – Measurement and Geometry
Ability Level:	A1 – Conceptual Understanding
Performance Indicator:	Identify shapes that have congruence, similarity, and/or symmetry of figures using a variety of methods, including transformational motions (e.g., translation/slide, rotation/turn, reflection/flip, enlargement/reduction) and models, drawings, and measurement tools.
Test Item:	

Which shape appears congruent to the shape drawn below?

Correct Response B:	The student should understand the concept of congruency. The two geometric shapes are congruent because they have the same size and shape.
Responses A, C, and D:	These responses are incorrect. They represent errors in which the student may not understand the concept of congruency. The shapes shown are not the same size and shape as the original shape.

5th GRADE MATHEMATICS

Reporting Category: C3 – Measurement and Geometry

Ability Level: A2 – Procedural Skills

Performance Indicator: Communicate the difference between perimeter and area.

Test Item:

Find the perimeter, in feet, of the square shown below.

12 feet

A   24 feet

B   48 feet

C   96 feet

D   144 feet

Correct Response B: The student should understand the concept of perimeter and be able to apply an algorithm for finding the perimeter of a square. The perimeter is the distance around a geometric shape.

Perimeter of a square = side length + side length + side length + side length = 12 + 12 + 12 + 12 = 48 feet

Perimeter of a square = 4 × side length = 4 × 12 = 48 feet

Response A: This response is incorrect. It represents an error in which the student may have added the length of only two sides of the square.

Response C: This response is incorrect. It represents an error in which the student may have incorrectly multiplied the length of one side of the square by the length of another side of the square.

Response D: This response is incorrect. It represents an error in which the student may have found the area of the square by finding the product of 12 and 12.

5th GRADE MATHEMATICS

Reporting Category:	C3 – Measurement and Geometry
Ability Level:	A3 – Problem Solving
Performance Indicator:	Determine totals and change due for monetary amounts in problem-solving situations.

Test Item:

> Donna and Dan combined their money to buy a gift and a cake for a friend's birthday. Donna had $13.25 and Dan had $15.75. If they spent $16.95 for a gift, how much money should they have left to buy the cake?
>
> A $12.05
>
> B $12.15
>
> C $13.00
>
> D $13.95

Correct Response A: The student should be able to reason that the difference between the sum of Donna's and Dan's money and the amount spent on a gift is the amount left.

$13.25 + $15.75 = $29.00, then $29.00 – $16.95 = $12.05

Response B: This response is incorrect. It represents an error in which the student may have performed the operation of subtraction incorrectly.

Response C: This response is incorrect. It represents an error in which the student may have rounded $29.00 to $30.00 and rounded $16.95 to $17.00 and then found the difference.

Response D: This response is incorrect. It represents an error in which the student may have performed the operation of subtraction incorrectly.

5th GRADE MATHEMATICS

Reporting Category: C4 – Data Analysis and Probability

Ability Level: A1 – Conceptual Understanding

Performance Indicator: Model and then compute measures of central tendency, including mean, median, and mode.

Test Item:

> The number of goals Cece's soccer team scored in each of the 11 games played this season are shown below.
>
> 0, 2, 0, 1, 0, 2, 1, 3, 2, 2, 1
>
> What is the mode of the number of goals scored per game by the team?
>
> A   0
>
> B   1
>
> C   2
>
> D   3

Correct Response C: The student should be able to recognize the mode of a set of data. The mode is the score that appears most often in the data set. In this case the number 2 appears the greatest number of times in the data set (four times).

Response A: This response is incorrect. It represents an error in which the student may have chosen the lowest score.

Response B: This response is incorrect. It represents an error in which the student may have chosen the median of the scores.

Response D: This response is incorrect. It represents an error in which the student may have chosen the highest score or the range of the scores.

5ᵗʰ GRADE MATHEMATICS

Category: C4 – Data Analysis and Probability

Ability Level: A2 – Procedural Skills

Performance Indicator: Model and then compute measures of central tendency, including mean, median, and mode.

Test Item:

> The math test scores in Ms. Smith's second period class are shown below.
>
> 80%, 95%, 84%, 62%, 86%, 95%, 72%
>
> What is the median test score?
>
> A   62%
>
> B   80%
>
> C   84%
>
> D   95%

Correct Response C: The student should be able to order the test score data from least to greatest and then select the median or middle score from the ordered data.

When ordered from least to greatest the scores are as follows:

62%, 72%, 80%, 84%, 86%, 95%, 95%,

The middle or median score is the fourth score from either end, which is 84%.

Response A: This response is incorrect. It represents an error in which the student may have chosen the lowest score or the middle score based on the order the scores were presented in the problem.

Response B: This response is incorrect. It represents an error in which the student may have incorrectly tried to find the mean of the test scores.

Response D: This response is incorrect. It represents an error in which the student may have chosen the mode of the scores, the score that appears most often.
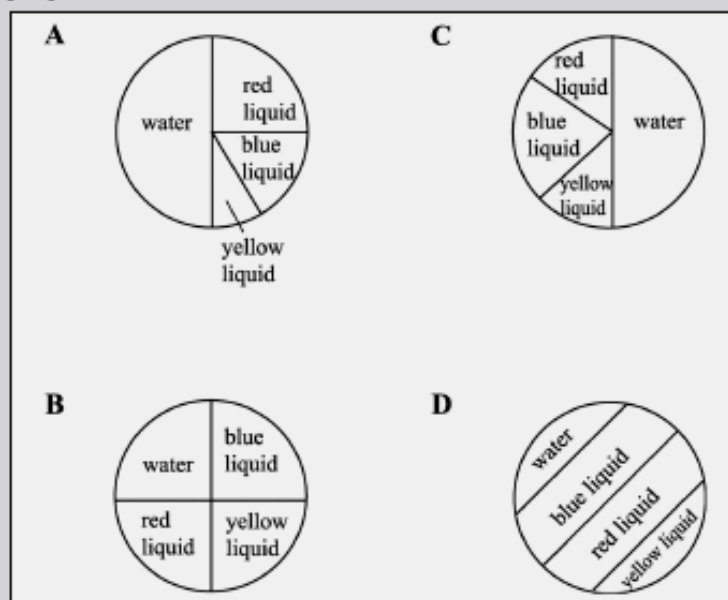
5ᵗʰ GRADE MATHEMATICS

Reporting Category: C4 – Data Analysis and Probability

Ability Level: A3 – Problem Solving

Performance Indicator: Collect, organize, read, and interpret data using a variety of graphic representations,   including tables, line plots, stem-and-leaf plots, scatter plots, histograms. Use data to draw and explain conclusions and predictions.

Test Item:

In science class, Jason made a mixture using 50% water, 25% red liquid, 20% blue liquid, and 5% yellow liquid. Which circle graph below best shows the mixture in its correct proportions?

A

water | red liquid / blue liquid / yellow liquid

C

red liquid | blue liquid | water | yellow liquid

B

water | blue liquid / red liquid | yellow liquid

D

water | blue liquid | red liquid | yellow liquid

Correct Response A: The student should understand how to read a circle graph. The half section of the circle labeled "water" represents 50% water. The quarter section of the circle labeled "red liquid" represents 25% red liquid. The just under one-quarter section of the circle labeled "blue liquid" represents 20% blue liquid. The smallest section of the circle labeled "yellow liquid" represents 5% yellow liquid.

Response B: This response is incorrect. The circle is divided into quarters, which represents 25% of each liquid.

Response C: This response is incorrect. The section of the circle for red should be one-fourth of the circle to represent 25%, but it is not.

Response D: This response is incorrect. Circle graphs should not be constructed using parallel lines to create sections.

1 What is the standard form of one hundred twenty-seven thousand, four hundred six?

A 127.46

B 12,746

C 127,406

D 127,416

2 A grocery store ordered 38 cases of soda. Each case holds 12 cans of soda. Which is the best ESTIMATE of the total number of cans of soda the store ordered?

A 200

B 400

C 600

D 800

3 When rounding the number 1,567 to the hundreds place, which digit in the number will be **most** helpful in deciding your answer?
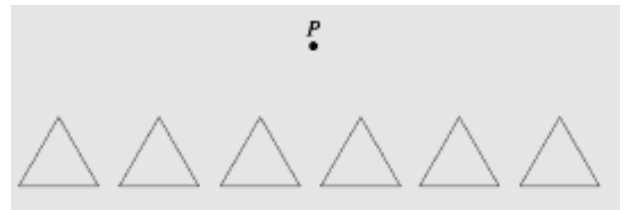
A 1

B 5

C 6

D 7

4 What is the perimeter of the figure below?
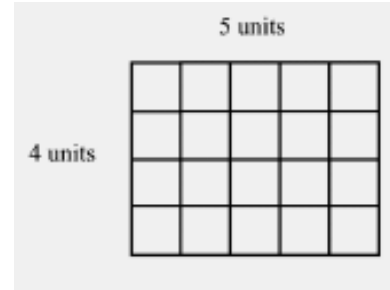
A 14 units

B 16 units

C 18 units

D 20 units

5 The six triangles shown below are equilateral and congruent.

If the triangles are moved so that one vertex from each triangle is attached to Point P and no triangles overlap, what regular polygon could be formed?

A rhombus

B octagon

C pentagon

D hexagon

6   In gym class, Dan jumped a distance of twelve feet, six inches. Kevin jumped ten feet, eight inches. How much farther did Dan jump than Kevin?

A   1'8"

B   1'10"

C   2'8"

D   2'10"

7   Pam chose the number 3 as the first term in a sequence. To get the next two terms after the first she used the rule "add 2, subtract 1." The first 7 terms in her sequence are shown below.

3, 5, 4, 6, 5, 7, 6, __, __

If she continues the pattern using the same rule, which should be the next two terms in Pam's number sequence?

A   7, 8

B   8, 7

C   8, 9

D   9, 10

8   Which is the **largest** whole number that can be used in place of n to make the inequality below true?

$n - 7 < 24$

A   29

B   30

C   31

D   32

9   Patricia plans to buy stuffed animals at the school fair. Each animal costs \$3.75. Which number sentence shows the total amount (t) in dollars it should cost Patricia to buy y animals?

A $t = 3.75 \times y$

B $t = 3.75 + y$

C $t = y - 3.75$

D $t = y \div 3.75$

10   Marianna decided to paint two walls in her room. Each wall is 8 feet tall and 12 feet long. What is the total area, in square feet, of the walls that Marianna plans to paint?

A   40 square feet

B   96 square feet

C   136 square feet

D   192 square feet

11 Cliff surveyed his classmates to find the percent of students who chose softball, baseball, football, volleyball, basketball, track, or soccer as their favorite sport. Which would be the **best** way for Cliff to display the data he collected so that it could be **quickly** understood by the class?

A stem-and-leaf plot

B circle graph

C box-and-whisker plot

D double bar graph

12 Connie recorded her height on her birthday for the 6 years shown in the table below.

Height on Birthday

Year	Height (inches)
1993	43.5
1994	47
1995	50
1996	53.25
1997	57.5
1998	60

Between which two consecutive years did Connie's height change the least?

A between 1993 and 1994

B between 1995 and 1996

C between 1996 and 1997

D between 1997 and 1998

13 The students in Ms. Thompson's class sold bars of chocolate for a fundraiser. The total number of bars sold by each student on the first day of the sale is shown below.

22, 7, 6, 1, 3, 12, 8, 4, 4, 0, 14, 4, 6

What is the mean of the number of bars sold by the students on the first day of the sale?

A 4

B 6

C 7

D 22

14 Richard donated 9 boxes of instant oatmeal to the school food drive. Each box contained 8 packets of oatmeal. What is the total number of packets of oatmeal Richard donated?

A 17

B 64

C 72

D 81

15 Sharon drew a picture of a square pyramid. What is the product of the number of faces and the number of edges of Sharon's pyramid?

A   40

B   25

C   13

D   10

Write your answer to Question 16 on page 6 in your Answer Booklet. Be sure to answer Parts A,B, and C.

---

16 The students in Ms. Spicer's class collected data on the number of cookies packaged in newly purchased one pound boxes of Jenny's Bite-Sized sugar cookies. The number of cookies they counted in different boxes of cookies is shown below.

50, 53, 48, 51, 51, 49, 51

A   What is the mode of the number of cookies counted in the boxes of cookies? Explain how you got your answer.

B   What is the median number of cookies per box? Show your work or explain how you got your answer.

C   Find the mean of the number of cookies per box in the 7 boxes studied. Round your answer to the nearer whole number. Show your work or explain how you got your answer.

Item Number	Reporting Category	Ability Level	Answer Key
1	C1	A1	C
2	C1	A2	B
3	C1	A3	C
4	C3	A1	C
5	C3	A1	D
6	C3	A2	B
7	C2	A1	B
8	C2	A2	B
9	C2	A3	A
10	C3	A3	D
11	C4	A1	B
12	C4	A2	D
13	C4	A3	C
14	C1	A1	C
15	C3	A3	A
16	C4	A2	CR*

* Indicates a constructed-response item. See the following page for the rubric and sample response.

Rubric for Question 16:

Score Point	Description
3	Student gives correct answer to Parts A, B, and C and shows appropriate work.
2	Student gives correct answer to any 2 parts and shows appropriate work. OR Student gives correct answer to all parts but does not show any appropriate work. (Student shows understanding of the problem, but makes minor computational errors.)
1	Student gives correct answer to one part only and shows appropriate work for that part. (Student demonstrates minimal understanding of the problem.)
0	Response is totally inaccurate and/or irrelevant, or there is no response.

Complete and Correct Response for Question 16 (similar to the following):

Part A   **51 cookies**

Explanation: The mode is the number(s) in a data set that appear(s) most frequently.

The number of cookies that appears most frequently in the data set is 51, which appears three times.

Part B   **51 cookies**

Work: The median is the middle number in a data set after the data has been ordered from least to greatest.

First, order the data as follows: 48, 49, 50, 51, 51, 51, 53

Then find the middle number, which is the fourth number in from either end. That number is 51.

Part C   **50 cookies (rounded down from 50.43)**

Work: To find the mean, divide the sum of the data by the number of pieces of data. First find the sum. $50 + 53 + 48 + 51 + 51 + 49 + 51 = 353$ Then, divide the sum by the number of pieces of data (which is 7): $353 \div 7 = 50.43$ which rounds down to 50.

8ᵗʰ GRADE MATHEMATICS

An overview of the Criterion Referenced Test program is provided at the beginning of this review guide. Information about the purpose, rationale & philosophy, accountability & alignment, development, and reporting can answer questions to the broader details of the program.

The materials that follow include the performance standards for grade 8, the matrix of the test configuration, and examples of test items. A number of test items include explanations for the correct answer and distracters of each test item. It is important to note that the following examples are examples. They are not intended to establish limits of what will be on the test or limits to the ways the standards can be assessed.

Content standards 1 through 5 deal with students' abilities to understand and use mathematical concepts. Listed below the five content standards are the performance indicators. Each standard has performance indicators that target specific competencies for grade 8 within the standard. The following is a description of the standards and those performance indicators tested. Those tested at the state level are check marked. The performance indicators for the process strands are also assessed; however, they are not reported separately.

Nevada Mathematics Standards and Progress Indicators

Standard 1: *Numbers, Number Sense, and Computation*
To solve problems, communicate, reason, and make connections within and beyond the field of mathematics, students will accurately calculate, use estimation techniques, number relationships, operation rules, and algorithms; they will determine the reasonableness of answers and the accuracy of solutions.

Grade 8 Progress Indicators

By the end of Grade 8, students know and are able to do everything required in the previous grades and:

✔ Read, write, add, subtract, multiply, and divide **real numbers** in various forms including **radicals**, exponential, and **scientific notation**.

✔ Compute with **rational** and **irrational numbers** to solve a variety of problems including rates, recipes, unit costs, and percents (e.g., discounts, interest, sale, prices, commissions, taxes).

• Explain and apply number theory and the properties of real numbers to solve problems.

✔ Compare and order rational numbers.

✔ Estimate in problem-solving situations and in practical applications; determine the reasonableness of the answer and verify the results.

✔ Explain the relationship among fractions, decimals, and percents; translate among various representations of equal numbers (e.g., from fractions to decimals to percents, various forms of "1" such as 3/3 or 16/16) to solve problems efficiently.

Standard 2: *Patterns, Functions, and Algebra*
To solve problems, communicate, reason, and make connections within and beyond the field of mathematics, students will use various algebraic methods to analyze, illustrate, extend, and create numerous representations (words, numbers, tables, and graphs) of patterns, functions, and algebraic relations as modeled in practical situations.

Grade 8 Progress Indicators

By the end of Grade 8, students know and are able to do everything required in the previous grades and:

✔ Use **inductive reasoning** to find the missing term in number and geometric patterns and to generalize basic patterns to the nth term, with and without calculators; use written, oral, and **symbolic language** to identify and describe patterns, **sequences**, and **functions**.

✔ Translate among verbal descriptions, graphic, tabular, and algebraic representations of mathematical situations.

✔ Identify, model, describe, and evaluate relationships, including functions, using a variety of methods with and without technology.

✔ Add and subtract **binomials**; describe the connection between the algebraic process and the arithmetic process.

✔ Describe how a change in one variable of a mathematical relationship affects the remaining variables using various tools and methods.

✔ Model, identify, and solve linear equations and inequalities; relate this process to the order of operations.

✔ Solve simple linear equations and connect that process to the order of operations.

Standard 3: *Measurement*
To solve problems, communicate, reason, and make connections within and beyond the field of mathematics, students will use appropriate tools and techniques of measurement to determine, estimate, record, and verify direct and indirect measurements.

Grade 8 Progress Indicators

By the end of Grade 8, students know and are able to do everything required in the previous grades and:

✔ Demonstrate an understanding of precision, error, and **tolerance** in measurement using the appropriate measurement tool to the required degree of accuracy.

✔ Select and apply appropriate formulas to solve problems; identify the relationship between changes in area and volume and changes in linear measures of figures.

✔ Apply ratios and proportions to calculate rates and as a method of **indirect measure** (e.g., miles per hour, cost per unit).

Standard 4:   *Spatial Relationships and Geometry*

To solve problems, communicate, reason, and make connections within and beyond the field of mathematics, students will identify, represent, explain, verify, and apply spatial relationships and geometric properties.

Grade 8 Progress Indicators

By the end of Grade 8, students know and are able to do everything required in the previous grades and:

✔ Apply the properties of equality and proportionality to solve problems involving congruent or similar shapes.

✔ Use coordinate geometry and models to change scale (enlarge and reduce).

✔ Use coordinate geometry to represent and interpret relationships defined by equations and formulas (including distance, midpoint, and slope), with and without technology.

✔ Form generalizations and **validate** conclusions about properties of geometric shapes including parallel lines, perpendicular lines, bisectors, triangles, and quadrilaterals.

✔ Verify and explain the Pythagorean Theorem using various methods (e.g., using grid paper, applying it to a missing side of a **right triangle**); determine missing sides and angles of triangles based on properties of their sides and angles.

• Use hand tools, technology, and models to construct figures and bisect angles and line segments; distinguish among **constructions**, sketches and drawings.

Standard 5:   *Data Analysis*

To solve problems, communicate, reason, and make connections within and beyond the field of mathematics, students will collect, organize, display, interpret, and analyze data to determine statistical relationships and probability projections.

Grade 8 Progress Indicators

By the end of Grade 8, students know and are able to do everything required in the previous grades and:

✔ Organize, display, read, and analyze data, with and without technology, using a variety of displays including box and whisker plots.

✔ Find the **theoretical probability** of an event using different counting methods (e.g., **tree diagrams**, **sample spaces**, and organized lists) and compare those results with actual (**experimental**) results, differentiating between the probability of an event and the **odds** of an event.

✔ Evaluate arguments that are based on data analysis for accuracy and validity; analyze the effect a change of scale or a change of format will have on statistical charts and graphs.

✔ Formulate reasonable inferences and projections based on **interpolations** and **extrapolations** of data to solve problems.

Standard 6: *Problem Solving*

Students will develop their ability to solve problems by engaging in developmentally appropriate problem solving opportunities in which there is a need to use various approaches to investigate and understand mathematical concepts in order to: formulate their own problems; find solutions to problems from everyday situations; develop and apply strategies to solve a wide variety of problems; and integrate mathematical reasoning, communication and connections.

Grade 8 Progress Indicators

By the end of Grade 8, students know and are able to do everything required in the previous grades and:

✔ Select, modify, develop, and apply strategies to solve a variety of mathematical and practical problems and to investigate and understand mathematical concepts.

✔ Apply previous experience and knowledge to new problem-solving situations.

✔ Verify, interpret, and evaluate results with respect to the original problem situation, determining an efficient **strategy** for the given situation.

• Try more than one strategy when the first strategy proves to be unproductive.

✔ Apply multi-step, integrated, mathematical problem-solving strategies, persisting until a solution is found or until it is clear that no solution exists.

• Generalize solutions and strategies from earlier problems to new problem situations.

✔ Interpret and solve a variety of mathematical problems by paraphrasing, identifying necessary and extraneous information, selecting and justifying efficient methods and/or strategies, and ensuring the answer is reasonable.

• Apply combinations of proven strategies and previous knowledge to solve non-routine problems.

• Use technology, including calculators, to solve problems and verify solutions.

• Use technology, including calculators, to investigate, define, and describe quantitative relationships such as patterns and functions.

Standard 7: *Mathematical Communication*

Students will develop their ability to communicate mathematically by solving problems in which there is a need to obtain information from the real world through reading, listening, and observing in order to: translate this information into a mathematical language and symbols; process this information mathematically; and present results in written, oral and visual formats.

Grade 8 Progress Indicators

By the end of Grade 8, students know and are able to do everything required in the previous grades and:

- Discuss and exchange ideas about mathematics as a part of learning.

- Use inquiry techniques (e.g., discussion, questioning, research, data gathering) to solve mathematical problems.

- Read expository text to learn about mathematics.

- ✔ Interpret and solve word problems without the necessity of key words or phrases.

- ✔ Model and explain mathematical relationships using oral, written, graphical, and algebraic methods.

- Evaluate the effectiveness of written and oral presentations of mathematics.

- Make conjectures and present arguments in discussions of mathematical ideas.

- Explain and evaluate thinking about mathematical ideas and solutions based on the role of definitions, properties, common rules, and symbols in solving problems.

- Use everyday language to explain thinking about strategies and solutions to mathematical problems.

- ✔ Express mathematical ideas and use them to define, compare, and solve problems orally and in writing.

- Use mathematical notation to communicate and explain mathematical situations.

Standard 8: *Mathematical Reasoning*

Students will develop their ability to reason mathematically by solving problems in which there is a need to investigate significant mathematical ideas and construct their own learning in all content areas in order to justify their thinking; reinforce and extend their logical reasoning abilities; reflect on and clarify their own thinking; and ask questions to extend their thinking.

Grade 8 Progress Indicators

By the end of Grade 8, students know and are able to do everything required in the previous grades and:

- Construct, justify, and defend mathematical conclusions using logical arguments, in situations related to mathematics, science, and technology.

- ✔ Use patterns and relationships to analyze mathematical situations; draw logical conclusions about mathematical problems.

- Follow a logical argument and judge its validity.

- ✔ Recognize and apply deductive and inductive reasoning in both concrete and abstract contexts.

- Ask questions to reflect on, clarify, and extend thinking.

Standard 8: *Continued*

Grade 8 Progress Indicators

- Review and refine the assumptions and steps used to derive conclusions in mathematical arguments.

- Construct valid arguments; make and test conjectures about algebraic and geometric properties based on mathematical principles.

- ✔ Determine relevant, irrelevant, and/or sufficient information to solve mathematical problems.

Standard 9: *Mathematical Connections*
Students will develop the ability to make mathematical connections by solving problems in which there is a need to view mathematics as an integrated whole, identifying relationships between context strands, and integrating mathematics with other disciplines, allowing the flexibility to approach problems in a variety of ways within and beyond the field of mathematics.

Grade 8 Progress Indicators

By the end of Grade 8, students know and are able to do everything required in the previous grades and:

- Link new concepts to prior knowledge.

- ✔ Use mathematical ideas from one area of mathematics to explain an idea from another area of mathematics.

- ✔ Use models to explain the relationship of concepts to procedures.

- Use the connections among mathematical topics to develop multiple approaches to problems.

- Use and analyze the connections between mathematics and other disciplines.

- Apply mathematical thinking and modeling to solve problems that arise in other disciplines (e.g., rhythm in music and motion in science).

- ✔ Identify, explain, and use mathematics in everyday life.

Constructed-Response Items

The constructed-response items present students with a question or questions that require students to respond in written form. Students receive a score of 0-3 points on their answer, with 0 being the lowest and 3 being the highest. A score of 2 or 3 is deemed proficient. For each constructed-response item, an item specific rubric is designed based on the general rubric. (See below for example.)

Score Point	Expectation
3	The response completely answers all parts of the question and displays thorough understanding of the skill(s) within the standard being tested. The response provides an answer that: • clearly and correctly indicates the mathematical ideas and processes applied and provides evidence of the problem-solving techniques and/or thinking skills used to solve the problem. • clearly and correctly labels all answers, if required.
2	The response partially, but adequately, answers the question and displays satisfactory understanding of the skill(s) being tested. The response provides an answer that: • correctly completes all parts of the task but contains minor flaws in the reasoning or a minor notational error in recording a solution to a part of the problem. • completes the entire task but uses incomplete, or disorganized information to represent the solution process and/or a problem solution.
1	The response demonstrates a limited understanding of the skill(s) being tested. The response provides an answer that: • correctly solves the problem but does not provide clearly acceptable answers for the entire problem. • provides an acceptable response for one part of the question, but fails to attempt a solution for the other part(s) of the problem
0	The response demonstrates a lack of understanding of the skill(s) being tested. The response provides an answer that: • does not answer the question clearly enough to demonstrate any understanding. • provides incorrect or inappropriate responses to the question.

8ᵗʰ GRADE MATHEMATICS

The rubric guide below is a tool that teachers and students can use to assist them in writing responses to the constructed-response items.

8ᵀᴴ GRADE CONSTRUCTED-RESPONSE ITEMS
RUBRIC GUIDE

The constructed-response questions are worth up to 3 points. Your answers to the constructed-response questions will be compared to high-quality examples. Use the rubric below to guide your responses.

SCORE POINT	EXPECTATION
Full Credit	• Your response addresses all parts of the question clearly and correctly. You use and label the proper math terms in your answer. • Your response shows all the steps you took to solve the problem.
Partial Credit	• Your response addresses most parts of the question correctly. • Your response does not show all of your work or does not completely explain the steps you took to solve the problem.
Minimal Credit	• Your response addresses only one part of the question correctly and explains the steps you took to solve that one part. In answering the remaining parts of the question, your response is incomplete or incorrect. • Your response does not show all of your work or does not explain all of the steps you took to solve the problem.
No Credit	• Your response is incorrect.

8ᵗʰ GRADE MATHEMATICS

The matrix below explains the configuration of the eighth grade mathematics examination.

CRT Grade 8 Mathematics Examination Item Matrix

Content Clusters/ Ability Levels (Cognitive Domains)	C1 Numbers and Operations	C2 Algebra and Functions	C3* Measurement and Geometry	C4 Data Analysis, Statistics, and Probability	Total Items	Percent
A1 Conceptual Understanding	5	4	7	6	22	41%
A2 Procedures	3	3	5	4	15	28%
A3 Problem Solving	4	4**	3**	6**	17	31%
Total Items	12	11	15	16	54	100%
Percent	22%	20%	28%	30%	100%	

*   Approximately half of the items in content Cluster 3 (C3) are from Standard 3 (Measurement) and the other half are from Standard 4 (Geometry).

** Indicates the possibility of a constructed-response item.

8th GRADE MATHEMATICS

Reporting Category: C1 – Numbers and Operations

Ability Level: A1 – Conceptual Understanding

Performance Indicator: Read, write, add, subtract, multiply, and divide real numbers in various forms including radicals, exponential, and scientific notation.

Test Item:

> The state of Missouri contains close to 6.5×10^4 acres of prairie land. What is 6.5×10^4 in standard notation?
>
> A   650,000
>
> B   65,000
>
> C   6,500
>
> D   650

Correct Response B: The student should recognize changing a number from scientific notation to standard notation means to multiply a number by a power of 10 as shown below.

6.5×10^4
$6.5 \times 10,000$ ($10^4 = 10,000$)
$65,000$

Response A: This response is incorrect. It represents an error in which the student may have left off the decimal in 6.5 and used 65 when multiplying by 10,000.

Response C: This response is incorrect. It represents an error in which the student may not have moved the decimal point enough spaces after multiplying 6.5 by 10,000.

Response D: This response is incorrect. It represents an error in which the student may have multiplied 6.5 by 10 instead of 10,000.

Reporting Category: C1 – Numbers and Operations

Ability Level: A2 – Procedural Skills

Performance Indicator: Estimate in problem-solving situations and in practical applications; determine the reasonableness of the answer and verify the results.

Test Item:

One thousand people were surveyed and asked which one amusement park ride out of a list of six was their most favorite ride. The table shows the results.

Most Favorite Ride

Ride	Number of People
Bumper Cars	142
Ferris Wheel	117
Free-Fall	213
Merry-Go-Round	93
Roller Coaster	248
Water Ride	187

Which percent is closest to the number of people in the survey who chose the Roller Coaster as their most favorite ride?

A   10%

B   25%

C   30%

D   35%

Correct Response B: The student should recognize that the percent of people in the survey who chose the Roller Coaster could be found by using a proportion.

$$\frac{\text{Part}}{\text{Whole}} = \frac{\text{People who chose the Roller Coaster}}{\text{Total Number of People in the Survey}}$$

$$\frac{n}{100} = \frac{248}{1000}$$

$$n = \frac{234 \cdot 100}{1000}$$

$$n = \frac{24800}{1000} = 24.8$$

$$n = 24.8$$

Therefore, the answer is 25% because it is closet to 24.8%.

Response A: This response is incorrect. The student may have accidentally misread the table and used the number of people who chose the Merry-Go-Round as their favorite ride instead of the Roller Coaster.

Response C: This response is incorrect. The student may have rounded 248 to 300 and proceeded to find the percent of people who chose the Roller Coaster as their most favorite ride. The problem with rounding 248 to 300 is that 248 is closer to 250 than 300.

Response D: This response is incorrect. The student may have compared the number of people who chose the Roller Coaster as their most favorite ride to all the people who did not.

8th GRADE MATHEMATICS

Reporting Category: C1 – Numbers and Operations

Ability Level: A3 – Problem Solving

Performance Indicator: Compute with rational and irrational numbers to solve a variety of problems including rates, recipes, unit costs, and percents (e.g., discounts, interest, sale, prices, commissions, and taxes.)

Test Item:

> Jackie has a part-time job selling magazine orders. The price for each magazine order is $40.00, which includes shipping and handling. There is an additional 8% sales tax charged on each magazine order. If each magazine order includes 12 issues, what is the price per magazine issue, including tax?
>
> A $4.00
>
> B $3.60
>
> C $3.33
>
> D $3.20

Correct Response B: The student should be able to recognize that division is involved in finding the price per issue. The total price of each magazine order should include sales tax before finding the price of each issue.

Step 1: Find the sales tax on one magazine order by multiplying $40.00 by 8%. Change the percent to decimal form.

$40.00 × 0.08 = $3.20

Step 2: Add the sales tax to one magazine order.

$40.00 + $3.20 = $43.20

Step 3: Divide the total price of one magazine order, which includes the sales tax, by 12.

$43.20 ÷ 12 = $3.60

Response A: This response is incorrect. The student may have added the price of one magazine order and sales tax then divided by the number of issues (e.g., (40 + 8) ÷ 12).

Response C: This response is incorrect. The student may have forgotten to include the sales tax charge and simply divided the price of each magazine order by the number of issues.

Response D: This response is incorrect. The student may have solved for the sales tax on one magazine order and confused it for the price of each issue.

8ᵗʰ GRADE MATHEMATICS

Reporting Category: C2 – Algebra and Functions

Ability Level: A1 – Conceptual Understanding

Performance Indicator: Use inductive reasoning to find the missing term in number and geometric patterns and to generalize basic patterns to the nth term, with and without calculators; use written, oral, and symbolic language to identify and describe patterns, sequence, and functions.

Test Item:

Matt was asked to construct a pattern based on the following rule.

Begin with a whole number and create a sequence by adding the same constant to each successive term to find the next term.

Which of these patterns follows the rule Matt used to construct his pattern?

A   1, 2, 4, 6, 10, …

B   1, 1, 2, 3, 5, …

C   0, 3, 6, 9, 12, …

D   0, 1, 3, 5, 7, …

Correct Response C: The student should be able to recognize that 3 is added to the first term and each successive term.

Response A: This response is incorrect. The student may have recognized that the same constant is added to the second and third terms but may have not noticed that a different constant is added to the first and fourth terms.

Response B: This response is incorrect. The student may have recognized that the same constant is added to the second and third terms but may have not noticed that a different constant is added to the first and fourth terms.

Response D: This response is incorrect. The student may have recognized that the same constant is added to the second, third, and fourth terms but may have not noticed that a different constant is added to the first term.

8th GRADE MATHEMATICS

Reporting Category: C2 – Algebra and Functions

Ability Level: A2 – Problem Solving

Performance Indicator: Identify, model, describe, and evaluate relationships, including functions, using a variety of methods with and without technology.

Test Item:

> Doug was playing a video game in which the player must complete an increasing number of stages. The table shows the number of stages that have to be completed in each of the first five levels of the game.
>
> | Level | Number of Stages |
> |:-----:|:----------------:|
> | 1 | 1 |
> | 2 | 3 |
> | 3 | 5 |
> | 4 | 7 |
> | 5 | 9 |
> | 6 | ? |
>
> Based on the number pattern in the table, which of these could be used to find the number of stages that have to be completed in the sixth level of the game, with x representing the level of the game?
>
> A $(2 - x)^2$
>
> B $x^2 - 1$
>
> C $1 - 2x$
>
> D $2x - 1$

Correct Response D: The student should be able to recognize that the number of stages is one less than twice the level number starting with level 2, then recognize that the same holds true for level 1.

Response A: This response is incorrect. This equation only works for levels 1 and 5.

Response B: This response is incorrect. This equation only works for level 2.

Response C: This response is incorrect. This equation gives the number of stages as negative integers.

8ᵗʰ GRADE MATHEMATICS

Reporting Category: C2 – Algebra and Functions

Ability Level: A3 – Problem Solving

Performance Indicator: Model, identify, and solve linear equations and inequalities; relate this process to the order of operations.

Test Item:

> **Write your answer to Question # on Page # in your Answer Booklet. Be sure to answer Parts A, B, and C.**
>
> Mr. Benavides gave his students two options on how to earn points on a class activity to review for a test. The options are shown below.
>
> **Option 1:** *5 points for each correct answer*
>
> **Option 2:** *10 points for participating and 3 points for each correct answer*
>
> **A** For each option, determine the number of points each student could earn if 15 questions were answered correctly? Show or explain how you got your answer.
>
> **B** If *c* represents the number of questions correctly answered and *p* represents the total number of points a student could earn, write an equation that could represent each option.
>
> **C** How many questions would have to be answered correctly in order for a student who chose option 1 and a student who chose option 2 to earn the same number of points? Show or explain how you got your answer.

Complete and Correct Response (similar to the following):

Part A: 75 points for option 1
               55 points for option 2

Work: For option 1, each correct answer is worth 5 points. Therefore, 15 correct answers × 5 points = 75 points.

               For option 2, a student automatically receives 10 points for participating and each correct answer is worth 3 points. Therefore, 10 points + (15 correct answers × 3 points) = 10 points + 45 points = 55 points.

Part B: $p = 5c$ for option 1
            $p = 10 + 3c$ for option 2

Part C: 5 correct answers

Work: To find out how many questions would have to be answered correctly for a
            student who chose option 1 and a student who chose option 2, the equations in
            Part B would have to be equal to each other.

$$5c = 10 + 3c$$
$$5c - 3c = 10 + 3c - 3c$$
$$2c = 10$$
$$c = 5$$

Score Point	Description
3	Student gives correct answer to Parts A, B, and C showing appropriate work.
2	Student gives correct answer to any two parts and shows appropriate work. OR Student gives correct answer to all parts but does not show any appropriate work. (Student shows understanding of the problem, but makes minor computational errors.)
1	Student gives correct answer to Part A and B only and shows appropriate work for that part. (Student demonstrates minimal understanding of the problem.)
0	Student's response is totally incorrect or irrelevant.

Reporting Category: C3 – Measurement and Geometry

Ability Level: A1 – Conceptual Understanding

Performance Indicator: Select and apply appropriate formulas to solve problems.

Test Item:
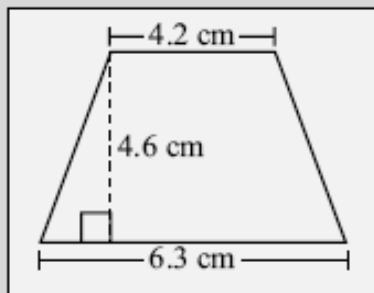
Which expression could be used to find the area, in square centimeters?

A $(4.2 + 6.3)(4.6)$

B $(4.2)(6.3)(4.6)$

C $\dfrac{(4.2 + 6.3)}{4.6}$

D $\dfrac{(4.2 + 6.3)(46)}{2}$

Correct Response D:	The student should use the formula for the area of a trapezoid. The formula to use for area of a trapezoid is: $$A = \frac{1}{2}(b_1 + b_2)(h)$$ Let $b_1 = 4.2$, $b_2 = 6.3$ and $h = 4.6$. Therefore by substitution, $$\frac{1}{2}(4.2 + 6.3)(4.6)$$

Response A: This response is incorrect. It represents an error in which the student may have not remembered to find the average of the bases before multiplying by the height.

Response B: This response is incorrect. It represents an error in which the student may have used the formula *lwh* because there are 3 measurements labeled on the trapezoid.

Response C: This response is incorrect. The student may have thought that the formula for the area of the trapezoid involved division and incorrectly divided by the height.
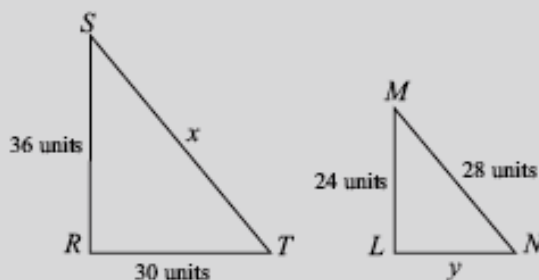
8th GRADE MATHEMATICS

Reporting Category: C3 – Measurement and Geometry

Ability Level: A2 – Procedural Skills

Performance Indicator: Apply the properties of equality and proportionality to solve problems involving congruent or similar shapes.

Test Item:

In the diagram below, $\triangle RST$ is similar to $\triangle LMN$.

What is the length of $\overline{ST}$?

A   42 units

B   35 units

C   28 units

D   20 units

Correct Response A:

The student should recognize that if $\triangle RST$ is similar to $\triangle LMN$, then $\overline{ST}$ corresponds to $\overline{MN}$. The length of $\overline{ST}$ could be found by using a proportion.

$$\frac{\text{the length of } \overline{ST}}{\text{the length of } \overline{SR}} = \frac{\text{the length of } \overline{MN}}{\text{the length of } \overline{ML}}$$

$$\frac{x}{36 \text{ units}} = \frac{28 \text{ units}}{24 \text{ units}}$$

$$x = \frac{28 \text{ units} \cdot 36 \text{ units}}{24 \text{ units}}$$

$$x = \frac{1008 \text{ units}}{24}$$

$$x = 42 \text{ units}$$

Therefore the length of $\overline{ST}$ is 42 units.

Response B: This response is incorrect. It represents an error in which the student may have used the length of side $\overline{RT}$ for the length of $\overline{RS}$.

Response C: This response is incorrect. It represents an error in which the student may have assumed the length of side $\overline{ST}$ was equal to its corresponding side $\overline{MN}$.

Response D: This response is incorrect. It represents an error in which the student may have solved for the length of side $\overline{LN}$.

8th GRADE MATHEMATICS

Reporting Category: C3 – Measurement and Geometry

Ability Level: A3 – Problem Solving

Performance Indicator: Estimate and convert units of measure for mass and volume within the same measurement system; compare corresponding units of the two systems.

Test Item:

> Linda is planning to make 3 gallons of fruit punch to serve at her club meeting. How many 12-ounce servings of punch can she serve with 3 gallons?
> (1 gallon = 128 ounces)
>
> A   36
>
> B   32
>
> C   15
>
> D   10

Correct Response B: The student should recognize that this problem involves finding the number of ounces equivalent to 3 gallons and the number of 12-ounce servings in 3 gallons of punch. This problem could be solved using proportions.

Step 1:

Let x represent the number of ounces in 3 gallons.

$$\frac{x}{3 \text{ gallons}} = \frac{128 \text{ ounces}}{1 \text{ gallon}}$$

$$x = \frac{(128 \text{ ounces})(3 \text{ gallons})}{1 \text{ gallon}}$$

$$x = 384 \text{ ounces}$$

Step 2:

Let y represent the number of servings in 3 gallons.

$$\frac{y}{384 \text{ ounces}} = \frac{1 \text{ serving}}{12 \text{ ounces}}$$

$$y = \frac{(1 \text{ serving})(384 \text{ ounces})}{12 \text{ ounces}}$$

$$y = 32 \text{ servings}$$

Response A: This response is incorrect. The student may have found the product of the number of gallons and then number of ounces in 1 serving, (i.e., 3 × 12).

Response C: This response is incorrect. The student may have found the sum of the number of gallons and the number of ounces in 1 serving, (i.e., 3 + 12).

Response D: This response is incorrect. The student may have found the quotient of the number of ounces in one gallon and the number of ounces in 1 serving, (i.e., 128 ÷ 12).

8th GRADE MATHEMATICS

Reporting Category: C4 – Data Analysis: Statistics and Probability

Ability Level: A1 – Conceptual Understanding

Performance Indicator: Organize, display, read, and analyze data, with and without technology, using a variety of displays including frequency distributions and circle graphs.

Test Item:

The stem-and-leaf plot below shows the number of requests for songs to be played each hour during a 16-hour segment.

Number of Calls Received each Hour

```
0 | 7 9
1 | 0 3 7 8
2 | 1 3 3 5 9
3 | 2 5 5 5
4 | 7
```

Key
4	3 represents 43

What is the range of the number of calls per hour?

A   47

B   40

C   35

D   23

Correct Response B: The student should know that the range of a set of data is the difference between the largest and smallest number in a set of data. The largest number in the data is 47 and the smallest number is 7. Therefore, 47 – 7 = 40.

Response A: This response is incorrect. The student may have confused the largest number for the range.

Response C: This response is incorrect. The student may have confused the mode for the range.

Response D: This response is incorrect. The student may have confused the median for the range.

8th GRADE MATHEMATICS

Reporting Category: C4 – Data Analysis: Statistics and Probability

Ability Level: A2 – Procedural Skills

Performance Indicator: Find the number of combinations possible in given situations using a variety of counting methods.

Test Item:

> Mr. Larson is having a family portrait done by Donavon's Portrait Studios. He could choose from five different backgrounds, three different portrait sizes, and four different poses. How many different combinations of one background, one portrait size, and one pose could he choose?
>
> A   60
>
> B   35
>
> C   19
>
> D   12

Correct Response A: The student should recognize that the fundamental counting principle could be applied here. The principle states that all possible outcomes in a situation can be found by multiplying the number of ways each event can occur.

5 backgrounds × 3 portrait sizes × 4 poses = 60 different combinations

Response B: This response is incorrect. The student may have added the number of different backgrounds to the product of the number of different portrait sizes and poses (e.g., 5 + 3 × 4 = 35).

Response C: This response is incorrect. The student may have added the product of the number of different backgrounds and portrait sizes by the different poses (e.g., 5 × 3 + 4 = 19).

Response D: This response is incorrect. The student may have added all three possible choices, number of different backgrounds, portrait sizes, and poses (e.g., 5 + 3 + 4 = 12).

8ᵗʰ GRADE MATHEMATICS

Reporting Category: C4 – Data Analysis: Statistics and Probability

Ability Level: A3 – Procedural Skills

Performance Indicator: Find the theoretical probability of an event using different counting methods (e.g., tree diagrams, sample spaces, and organized lists) and compare those results with actual (experimental) results, differentiating between the probability of an event and the odds of an event.

Test Item: Olivia has a bag that contains different flavored pieces of candy. The bag contains the following amounts of different flavors: 4 strawberry, 2 lemon, 3 apple, and 1 orange. If Olivia takes one candy from this bag at random, what are the odds that it will be a lemon-flavored candy?

A   4 to 5

B   3 to 4

C   1 to 4

D   1 to 5

Correct Response C: The student should recognize that the odds in favor of an event taking place is the ratio shown below:

number of favorable outcomes .
number of unfavorable outcomes

The favorable outcome in Olivia's situation would be the 2 lemon-flavored pieces of candy. Her unfavorable outcome would be 10 pieces of candy minus the 2 lemon-flavored ones, which would be 8 different pieces of candy that are not lemon-flavored.

Therefore,

$$\frac{\text{number of lemon-flavored pieces of candy}}{\text{number of pieces of candy not lemon-flavored}} = \frac{2}{10-2} = \frac{2}{8} = \frac{1}{4} \text{ or 1 to 4.}$$

Response A: This response is incorrect. This is the probability of Olivia randomly not taking out a lemon-flavored piece of candy.

Response B: This response is incorrect. This is the odds against Olivia randomly not taking out a lemon-flavored piece of candy.

Response D: This response is incorrect. This is the probability of Olivia randomly not taking out a lemon-flavored piece of candy.

1 Charlene helps to construct stages for concerts. She needs to increase the size of the stage shown below.
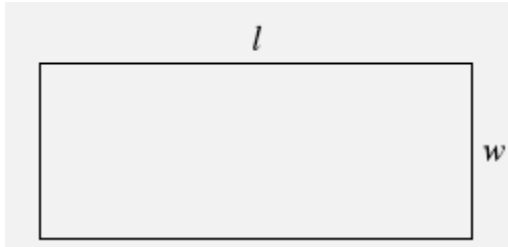
Charlene plans to create a new stage by doubling l, the length, and doubling w, the width, of the original stage. Which of these could represent the area of the new stage?

A　lw

B　$2lw$

C　$4lw$

D　$8lw$

2 An 8-inch by 10-inch photograph is reduced by a scale of $\frac{3}{5}$.

What is the length of the shortest side of the reduced photograph?

A　3.2 in

B　4.8 in

C　5.0 in

3 If 16% of the 150 eighth graders who attend Middletown Middle School went on a field trip to the local planetarium, which fraction is equivalent to the number of students who went on the field trip?

A　$\frac{1}{4}$

B　$\frac{8}{75}$

C　$\frac{1}{16}$

D　$\frac{4}{25}$

4 Ben and Sue both left Martha's house at the same time. Ben drove 60 miles due east to get home. Sue drove 80 miles due west to get home. How much farther away from Martha's house is Sue than Ben?

A　20 miles

B　60 miles

C　80 miles

D　140 miles

5 Peter was looking at his paycheck and noticed that 28% of his weekly salary is taken out for taxes and other deductions. This means he only gets to keep 72% of his weekly income. In the equation below, *I* represents Peter's weekly income and s represents his weekly salary.

$I = 0.72\ s$

What would happen to Peter's weekly income, *I*, if his weekly salary, *s*, increased by 10% ?

A It would increase by 10%.

B It would increase by 18%.

C It would increase by 20%.
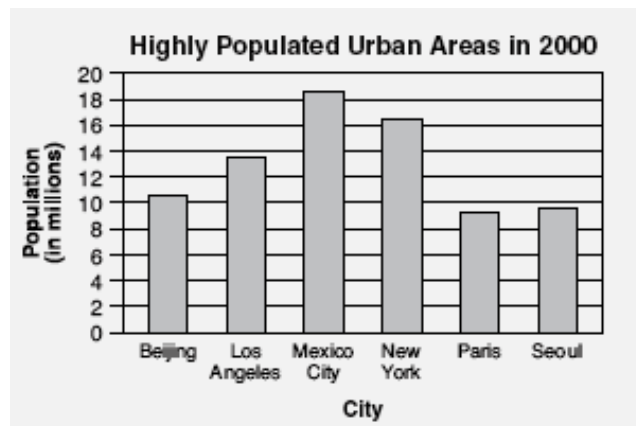
D It would increase by 28%.

6 Which of the following best represents the sentence below?

If a number is multiplied by 2 and then 6 is subtracted from the product, the result is 20.

A $2 \cdot 6 - n = 20$

B $n - 2 \cdot 6 = 20$

C $6n - 2 = 20$

D $2n - 6 = 20$

7 The graph below shows the populations for 6 large cities.


Highly Populated Urban Areas in 2000

Based on the graph, which of the following is a true statement?

A New York City's population is close to 6 million greater than Beijing's population.

B The sum of the populations of Paris and Seoul are less than the population of Los Angeles.

C The difference in population between Paris and Beijing is less than 1 million.

D Mexico City's population is close to 45% greater than the population of Los Angeles.

8   The box-and-whiskers plot below shows the data from the scores for the winning teams in the ten Super Bowls from 1994 through 2003.
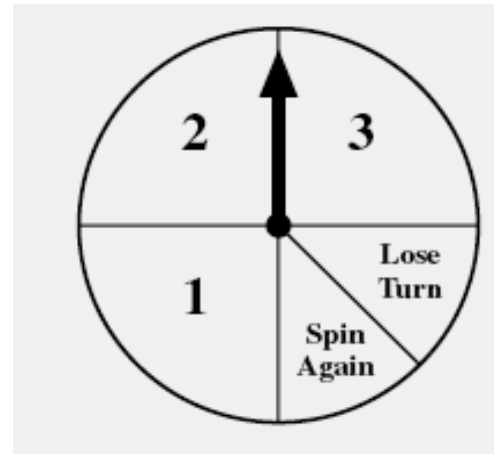

Winning Teams' Scores in the Super Bowl from 1994 to 2003
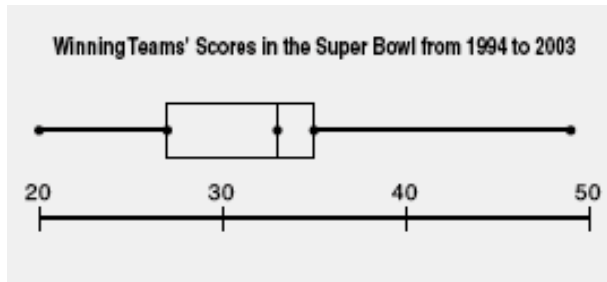
Based on the graph, which of these is closest to the median of the data?

A   37

B   33

C   27

D   20

9   Noah and Dave played a board game that used the spinner shown below. The "Lose Turn" and "Spin Again" sections are each one-half the size of one of the numbered sections.

On his turn, Dave spun the arrow on the spinner one time. Which of these is a true statement about the outcome of his spin?

A   An outcome of "1" or "2" is equally likely.

B   An outcome of "Spin Again" is not possible.

C   An outcome of "3" is more likely than an outcome of "1".

D   An outcome of "2" is less likely than an outcome of "Lose Turn".

10 During tennis practice, each of the 6 girls on the team played one game with each of the other girls. In all, how many games were played?

A 6

B 12

C 15

D 36

11 Brad solved the inequality below.

$2x + 7 < -13$

What value of x makes the inequality true?

A $x < 10$

B $x < 3$

C $x < -3$

D $x < -10$

12 On Monday, four friends went to their favorite bookstore and each one purchased the same 1019-page book. At the end of the week, each friend told one another the best estimate of how much of the book each had read.
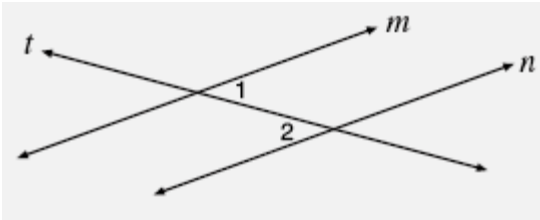
Amount of Book Read	
Friend	Fraction Read
Brent	$\frac{10}{12}$
Latoya	$\frac{6}{13}$
Vanessa	$\frac{4}{11}$
Zeke	$\frac{7}{9}$

According to the table above, which friend had read the least amount of pages?
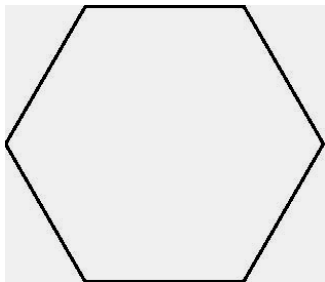
A Brent

B Latoya

C Vanessa

D Zeke

13 In the diagram below, lines *m* and *n* are intersected by line *t* and form the numbered angles.

To prove that lines m and n are parallel, what must the measure of <2 be if <1 measures 55 degrees?

  A   35 degrees

  B   55 degrees

  C   125 degrees

  D   145 degrees

14 Pictured below is a regular hexagon.

What is the sum of the interior angles of the regular hexagon?

  A   180°

  B   360°

  C   720°

  D   1080°

15 Which of the following expressions represents the difference of the polynomials $(3x + 1)$ and $(x + 9)$?

  A $4x - 8$

  B $2x + 8$

  C $2x - 8$

  D $5x$

> **Write your answer to Question 16 on Page #15 in your Answer Booklet.**
> **Be sure to answer Parts A, B, and C.**

16 A band director sketched line segments $\overline{EF}$ and $\overline{GH}$ as shown on the graph below. The line segments represent the path two different groups of band members will follow during part of their halftime routine.
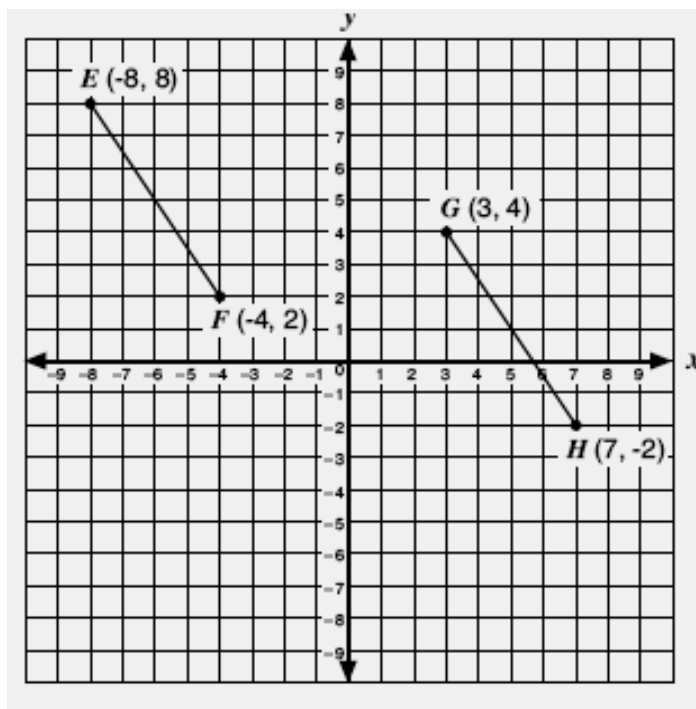
A Find the distance of line segments EF and GH. The distance formula is

$$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Show or explain how you got your answer.

B Find the distance of line segments EF and GH. The distance formula is

$$\frac{(y_2 - y_1)}{(x_2 - x_1)}$$

Show or explain how you got your answer.

C According to your answers in part A and B, are the paths represented by line segments EF and GH equal in length and parallel? Explain how you got your answer.

Item Number	Reporting Category	Ability Level	Answer Key
1	C3	A3	C
2	C3	A2	B
3	C1	A2	D
4	C1	A3	A
5	C2	A3	B
6	C2	A1	D
7	C4	A2	A
8	C4	A1	B
9	C4	A2	A
10	C4	A3	C
11	C2	A2	D
12	C1	A1	C
13	C3	A1	B
14	C3	A2	C
15	C2	A2	B
16	C3	A3	*

* Indicates a constructed-response item. See the following page for the rubric and sample response.

Rubric for Question 16:

Score Point	Description
3	Student gives correct answer to Parts A, B, and C, showing appropriate work.
2	Student gives correct answer to any two parts and shows appropriate work. OR Student gives correct answer to all parts but does not show any appropriate work. (Student shows understanding of the problem, but makes minor computational errors.)
1	Student gives correct answer to Part A and B only and shows appropriate work for that part. (Student demonstrates minimal understanding of the problem.)
0	Student's response is totally incorrect or irrelevant.

Complete and Correct Response for Question 16 (similar to the following):

Part A: Line segment $\overline{EF}$ is $\sqrt{52}$ units or close to 7.2 units in length.
Line segment $\overline{GH}$ is $\sqrt{52}$ units or close to 7.2 units in length.

Work: To find the slope of each line segment, use the distance formula and substitute the ordered pairs in their designated places.

$$mEF = \sqrt{(-4-(-8))^2 + (2-8)^2} = \sqrt{4^2 + (-6)^2} = \sqrt{16+36} = \sqrt{52} = 7.2$$

$$mGH = \sqrt{(7-3)^2 + (-2-4)^2} = \sqrt{4^2 + (-6)^2} = \sqrt{16+36} = \sqrt{52} = 7.2$$

Part B: The slope of line segment $\overline{EF}$ is $-\frac{6}{4}$ or $-\frac{3}{2}$

The slope of line segment $\overline{GH}$ is $-\frac{6}{4}$ or $-\frac{3}{2}$

Work: To find the slope of each line segment, use the slope formula and substitute the ordered pairs in their designated places.

Slope of line segment $\overline{EF} = \frac{8-2}{-8-(-4)} = \frac{8-2}{-8+4} = -\frac{6}{4} = -\frac{3}{2}$

Slope of line segment $\overline{GH} = \frac{8-2}{-8-(-4)} = \frac{8-2}{-8+4} = -\frac{6}{4} = -\frac{3}{2}$

Part C: Line segments $\overline{EF}$ and $\overline{GH}$ are equal in distance and parallel.

Explanation: Both line segments are equal in distance as shown in part A and parallel because their slopes are the same as shown in part B.